Cisco 3200 Series Router Hardware Reference

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Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

Text Part Number: OL-5816-10

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- Move the equipment to one side or the other of the television or radio.

- Move the equipment farther away from the television or radio.

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Cisco 3200 Series Router Hardware Reference

CONTENTS

Introduction to the Cisco 3200 Series Routers

The Cisco 3200 Series routers provides industry-standard network software features that run on ruggedized hardware, suitable for harsh environments. A router includes a combination of mobile interface cards and a Cisco 3200 Rugged Enclosure. The following major components are available from Cisco:

- Cisco 3200 Rugged Enclosures
- Cisco 3270 Rugged Router card
- Mobile Access Router Card (MARC)
- Fast Ethernet Switch Mobile Interface Cards (FESMICs)
- Serial Mobile Interface Cards (SMICs)
- Wireless Mobile Interface Cards (WMICs)

This document describes the Cisco cards and the enclosure solutions that are used to assemble Cisco 3200 Series routers. A router can be purchased as a complete unit or purchased in part from Cisco and assembled by a qualified system integrator (SI) as a custom solution. For example, a qualified SI might assemble cards into a custom enclosure to suit a particular environment. Custom solutions based on Cisco cards must include a power source, cables, and an enclosure. For information about the specific hardware configuration of your router, contact your SI.

The following chapters provide information that you need for understanding the physical components of a completed Cisco 3200 Series router. This document is not intended to cover assembly or repair instructions.

Chapter 1, “Cisco 3270 Rugged Enclosure,” describes the enclosures that house the Cisco 3200 Series routers.

Chapter 2, “Cisco 3270 Rugged Router Card,” describes the Cisco 3270 Rugged Router card layout.

Chapter 3, “Mobile Access Router Card,” describes the MARC layout.

Chapter 4, “Fast Ethernet Switch Mobile Interface Card,” describes the FESMIC layout, ports, and buses.

Chapter 5, “Serial Mobile Interface Card,” describes the SMIC layout, ports, and buses.

Chapter 6, “Wireless Mobile Interface Cards,” describes the WMIC layout, ports, and buses.

Appendix A, “Smart Serial Port External Seal,” describes how to seal the Smart Serial port.

Appendix B, “SFP Module Replacement,” describes how to install and remove small form-factor pluggable (SFP) modules on the Cisco 3270 Rugged Router card.

Audience and Scope

The audience for this document is the system administrator (SA), the SI, and the system engineer (SE). They are experts with networking industry training and experience. We assume that users are familiar with the terminology and concepts of the PC-104, Cisco IOS software, and Mobile IP networking.

The SA, SI, or SE refers to this document to understand how the router hardware is connected to peripheral devices and to perform minor troubleshooting on the cards in an existing router. Although they might not be specifically identified as SAs, SIs, or SEs, all users of this documentation are assumed to have comparable skills and knowledge.

Related Documentation

You can access these documents on the Documentation page on Cisco Connection Online (CCO) at www.cisco.com. The following documentation is available at the http://www.cisco.com/en/US/products/hw/routers/ps272/tsd_products_support_series_home.html:

- *Release Notes for the Cisco 3200 Series Mobile Access Routers* (78-13975)—Provides information about accessing documentation and technical assistance for the Cisco 3200 Series router.
- *Radio Channels and Transmit Frequencies*(OL-11491-03)—Description of how to determine the radio type and how to configure radio channel spacing, radio channel or frequency, and Dynamic Frequency Selection (DFS).
- *Roles and the Associations of Wireless Devices*(OL-11494-03)—Description of the roles Cisco wireless devices can be assigned and how the role of a device affects its ability to associate or not associate with other wireless devices.
- *Cisco 3200 Series Wireless MIC Software Configuration Guide* (OL-6415-05)—Provides sample procedures for using the IOS commands to configure Wireless Mobile Interface Cards (WMICs).
- *Cisco 3200 Series Mobile Access Router Software Configuration Guide* (OL-1926-06)—Provides sample procedures for using the Cisco IOS commands to configure the Cisco 3270 Rugged Router card or the Mobile Access Router Card (MARC) in Cisco 3200 Series routers.
- *Cisco 3200 Series Mobile Access Router Hardware Reference* (OL-5816)—(This book) Provides descriptions of the Cisco MIC I/O cards in the Cisco 3200 Series routers.
- *Cisco 3200 Series Mobile Access Router Reference Sell Document* (OL-3880)—Presents an overview of the reference sell program and components for the Cisco 3200 Series router.
- *Regulatory Compliance and Safety Information for the Cisco 3200 Mobile Access Router* (78-16930)—Provides regulatory compliance and safety information.

The release notes that list the enhancements to and caveats for Cisco IOS releases that pertain to the Cisco 3200 Series router are available at:

http://www.cisco.com/en/US/products/sw/iosswrel/products_ios_cisco_ios_software_releases.html

or

http://www.cisco.com/en/US/products/sw/iosswrel/ps5012/ps4629/index.html

For information about using Cisco IOS software to configure SNMP, see to the following documents:

- The “Configuring SNMP Support” chapter of the *Cisco IOS Configuration Fundamentals Configuration Guide,* Release 12.2
- The “SNMP Commands” chapter of the *Cisco IOS Configuration Fundamentals Command Reference,* Release 12.2

For information about using Cisco IOS software to configure Simple Network

Management Protocol (SNMP) Management Information Base (MIB) features, see to the appropriate documentation for your network management system.

For information on configuring Mobile IP using Cisco IOS software, see to the following documents:

- The "Configuring Mobile IP" chapter of the *Cisco IOS IP Configuration Guide,* Release 12.2
- The "Mobile IP Commands" chapter of the *Cisco IOS IP Command Reference, Volume 1 of 3: Addressing and Services,* Release 12.2

Related documents from the Cisco TAC Web pages include:

- Antenna Cabling

  http://www.cisco.com/warp/public/102/wlan/antcable.html

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS version 2.0.

Conventions

This publication uses these conventions to convey instructions and information:

Command descriptions use these conventions:

- Commands and keywords are in boldface text.
- Arguments for which you supply values are in italic.
- Square brackets ([ ]) mean optional elements.
- Braces ({ }) group required choices, and vertical bars (|) separate the alternative elements.
- Braces and vertical bars within square brackets ([{ | }]) mean a required choice within an optional element.

Interactive examples use these conventions:

- Terminal sessions and system displays are in `screen` font.
- Information you enter is in **`boldface screen`** font.
- Nonprinting characters, such as passwords or tabs, are in angle brackets (< >).

Notes, cautions, and timesavers use these conventions and symbols:

Tip Means the following will help you solve a problem. The tips information might not be troubleshooting or even an action, but could be useful information.

Note Means reader take note. Notes contain helpful suggestions or references to materials not contained in this manual.

Caution Means reader be careful. In this situation, you might do something that could result in equipment damage or loss of data.

Warning **This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. (To see translations of the warnings that appear in this publication, refer to the appendix "Translated Safety Warnings.")**

Waarschuwing **Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen. (Voor vertalingen van de waarschuwingen die in deze publicatie verschijnen, kunt u het aanhangsel "Translated Safety Warnings" (Vertalingen van veiligheidsvoorschriften) raadplegen.)**

Varoitus **Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista. (Tässä julkaisussa esiintyvien varoitusten käännökset löydät liitteestä "Translated Safety Warnings" (käännetyt turvallisuutta koskevat varoitukset).)**

Attention **Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant entraîner des blessures. Avant d'accéder à cet équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures courantes de prévention des accidents. Pour obtenir les traductions des mises en garde figurant dans cette publication, veuillez consulter l'annexe intitulée « Translated Safety Warnings » (Traduction des avis de sécurité).**

Warnung **Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt. (Übersetzungen der in dieser Veröffentlichung enthaltenen Warnhinweise finden Sie im Anhang mit dem Titel "Translated Safety Warnings" (Übersetzung der Warnhinweise).)**

Avvertenza **Questo simbolo di avvertenza indica un pericolo. Si è in una situazione che può causare infortuni. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti. La traduzione delle avvertenze riportate in questa pubblicazione si trova nell'appendice, "Translated Safety Warnings" (Traduzione delle avvertenze di sicurezza).**

Advarsel **Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du være oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker. (Hvis du vil se oversettelser av de advarslene som finnes i denne publikasjonen, kan du se i vedlegget "Translated Safety Warnings" [Oversatte sikkerhetsadvarsler].)**

Aviso **Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos fisicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes. (Para ver as traduções dos avisos que constam desta publicação, consulte o apêndice "Translated Safety Warnings" - "Traduções dos Avisos de Segurança").**

¡Advertencia! **Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes. (Para ver traducciones de las advertencias que aparecen en esta publicación, consultar el apéndice titulado "Translated Safety Warnings.")**

Varning! **Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador. (Se förklaringar av de varningar som förekommer i denna publikation i appendix "Translated Safety Warnings" [Översatta säkerhetsvarningar].)**

CHAPTER 1

Cisco 3200 Rugged Enclosures

This chapter provides an overview of the Cisco 3200 Rugged Enclosures so that simple troubleshooting, such as reconnecting a loose cable, can be performed in the field. The chapter is not intended as a complete guide to the chassis, because the devices should be serviced or repaired by a qualified personnel.

The enclosure seals the Cisco 3200 Series router cards so that they can withstand the harsh environments that are common in police cars, military vehicles, trains, airborne vehicles, and outdoor locations that are exposed to the elements.

Cisco 3200 Rugged Enclosure features include:

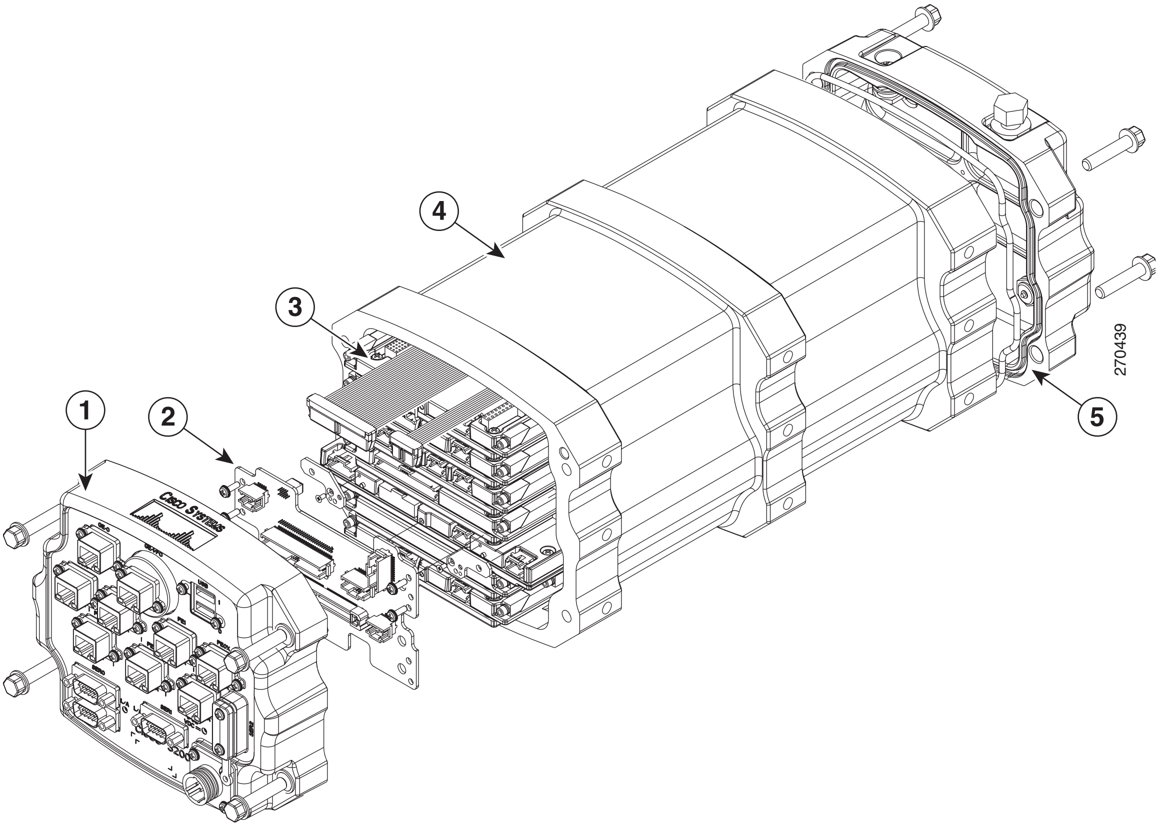
- Symmetrical mounting holes for the mounting brackets, so that the unit can be mounted upside-down if required.
- A design that meets NEMA4 requirements (impervious to rain or hose-directed water). The enclosure is slightly rounded on the top and bottom. This provides a non-pooling surface in case the enclosure is exposed to water.
- Maximum heat dissipation. Thermally conductive pads and thermal vias around the board perimeter of each card physically contact thermal plates that physically contact the aluminum chassis. This minimizes the overall board thermal rise by transferring heat into the surrounding environment.

The Cisco 3200 Rugged Enclosures are available as:

- A fully assembled Cisco 3270 Rugged Enclosure that supports the Cisco 3270 Rugged Router card, up to five mobile interface cards, and one Cisco Mobile Router Power Card (MRPC).
- A fully assembled Cisco 3230 Rugged Enclosure that supports the Mobile Access Router Card (MARC), up to five mobile interface cards (MICs), and one MRPC.

Figure 1-1 shows an exploded view of a Cisco 3230 Rugged Enclosure. (The design of the longer Cisco 3270 Rugged Enclosure is similar.)

Figure 1-1 Exploded View of a Rugged Enclosure



1	I/O end cap[1]	**2**	Wiring card
3	Card stack	**4**	Extrusion (body of the enclosure)
5	Antenna end cap		

[1] This end cap shows four serial ports, but the typical configuration has two serial ports.

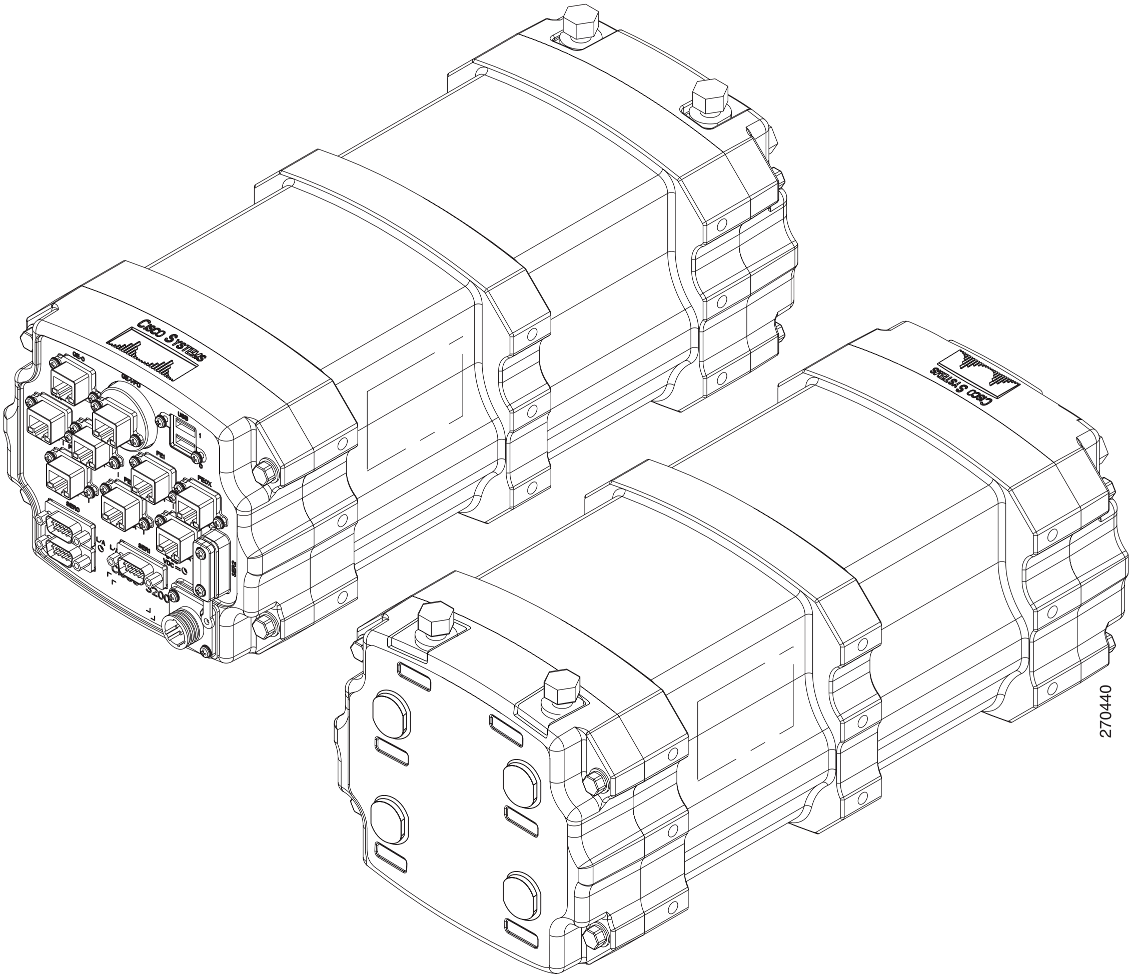
The enclosures are sealed by using O-rings between the extrusion and the end caps.

Cisco 3270 Rugged Enclosure

The Cisco 3270 Rugged Enclosure operates in a temperature range from –40 to +165°F (–40 to +74°C) when all ports are copper. If the Cisco 3270 Router includes a fiber-optic port, it operates at a temperature range from –40 to +147°F (–40 to +64°C).

The Cisco 3270 Rugged Enclosure is designed to meet NEMA4 requirements. Figure 1-2 shows an example of a fully assembled Cisco 3270 Rugged Enclosure. Note the greater length to accommodate the Cisco 3270 Rugged Router card and future expansion.

Figure 1-2 Cisco 3270 Rugged Enclosure



Cisco 3270 Router Card Stack

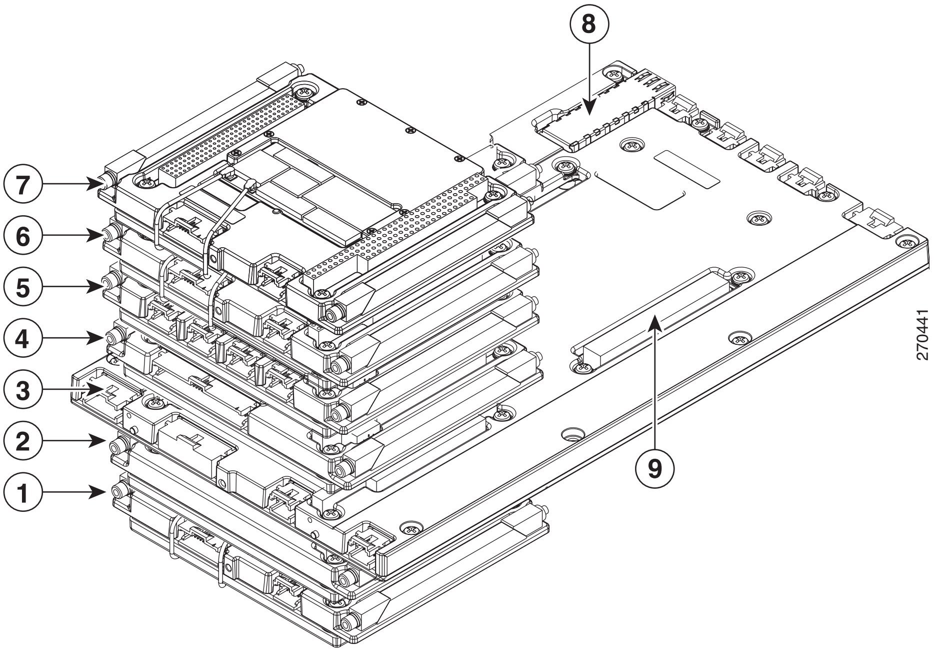
The Cisco 3270 Rugged Enclosure supports the following configurations:

- One Cisco 3270 Rugged Router card
- Up to three Wireless Mobile Interface Cards (WMICs)
- One Serial Mobile Interface Card (SMIC)
- One Fast Ethernet Switch Mobile Interface Card (FESMIC)
- One Cisco Mobile Router Power Card (MRPC)

A base configuration includes one of each of the following: Cisco 3270 Rugged Router card, SMIC, FESMIC, and MRPC.

In the Cisco 3270 Rugged Enclosure, the cards should be stacked in the order shown in Figure 1-3. The figure includes three optional WMICs. If WMICs are added, the first WMIC should be installed on the bottom of the stack, and the next two WMICs should be installed at the top of the stack.

Figure 1-3 Example of a Cisco 3270 Router Card Stack with Three Optional WMICs

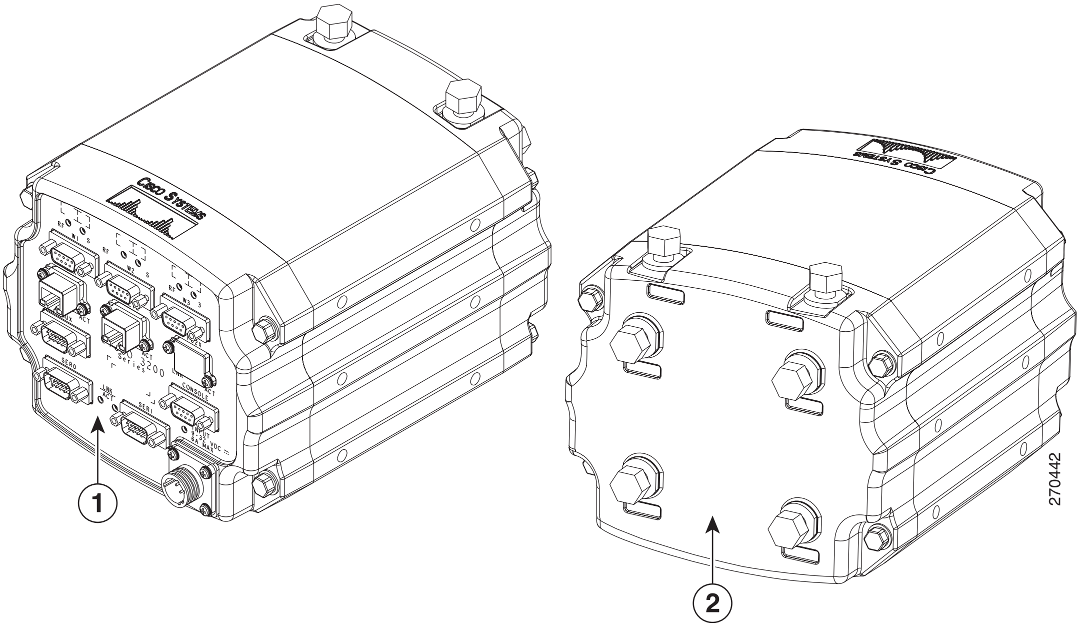


1	WMIC 1	**2**	MRPC
3	MARC	**4**	SMIC
5	FESMIC	**6**	WMIC 2
7	WMIC 3	**8**	Small-form-factor pluggable (SFP) module
9	Second PCI bus		

Cisco 3230 Rugged Enclosure

The Cisco 3230 Rugged Enclosure is designed to accommodate the Mobile Access Router Card (MARC). This enclosure operates in a temperature range from –40 to 165°F (–40 to +74°C), and is certified to meet NEMA4 requirements. Figure 1-4 shows an example of a Cisco 3230 Rugged Enclosure.

Figure 1-4 Cisco 3230 Rugged Enclosure



1	Front of the enclosure (I/O end cap)[1]	2	Back of the enclosure (antenna end cap)

[1] This end cap shows four serial ports, but the typical configuration has two serial ports.

Cisco 3230 Router Card Stack

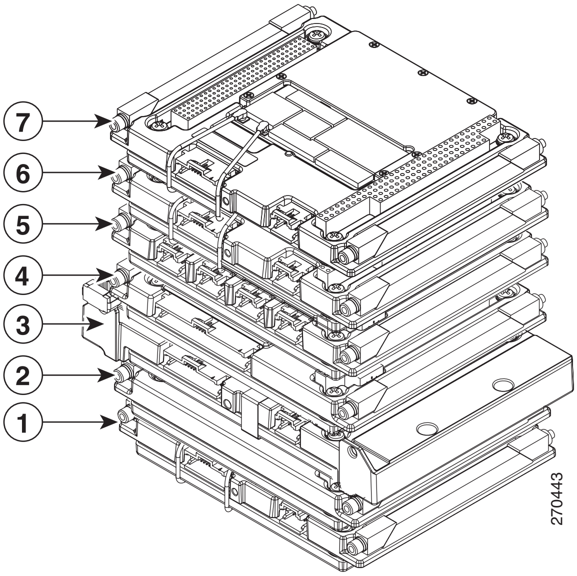
The Cisco 3230 Rugged Enclosure can accommodate up to seven cards, including:

- One MARC
- Up to three WMICs
- One SMIC (or no SMIC)
- One FESMIC
- One MRPC

A basic configuration includes one of each of the following: MARC, SMIC, FESMIC, WMIC, and MRPC.

In the Cisco 3230 Rugged Enclosure, the cards should be stacked in the order shown in Figure 1-5. The two optional WMICs are on the top of the stack.

Figure 1-5 Cisco 3230 Router Stack



1	WMIC 1	**2**	MRPC
3	MARC	**4**	SMIC
5	FESMIC	**6**	WMIC 2
7	WMIC 3		

Rugged Enclosure End Caps

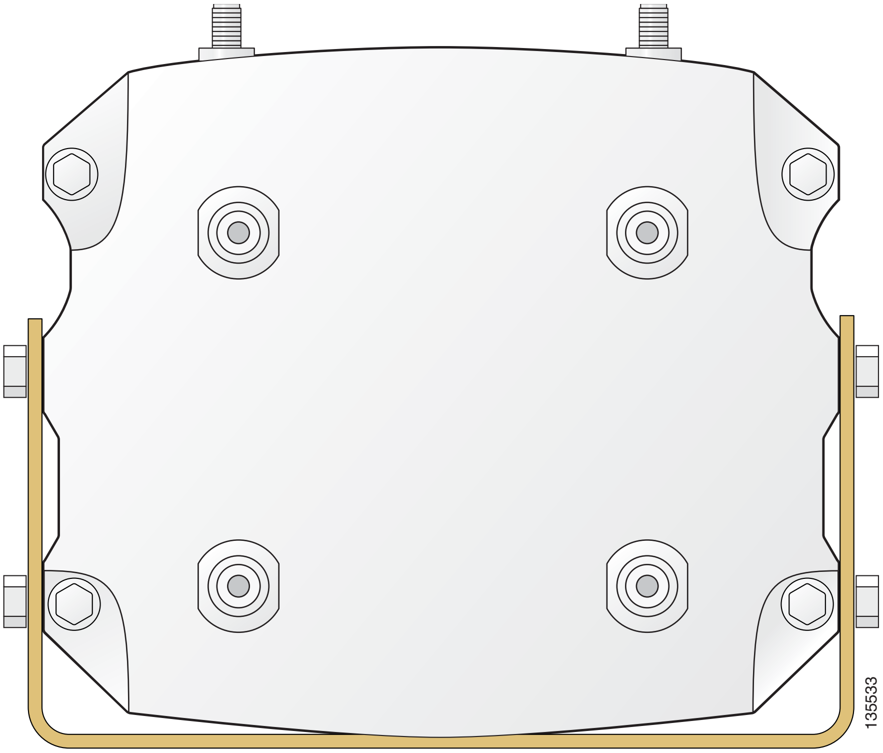
Each Cisco 3200 Rugged Enclosure has two end caps: an antenna end cap that connects to the back of the enclosure, and an I/O end cap that connects to the front of the enclosure. The port configurations of the I/O end caps vary, based on the contents of the enclosure. For example, the number and location of antenna ports installed on the antenna end cap depend on how many WMICs are installed in the enclosure.

Note To prevent exposure to the elements, we recommend using the protective port covers (provided) on ports that are not in use and using port covers (provided) on the mating cables.

Antenna End Cap

The antenna end cap has four antenna ports on the flat side and two ports on the top surface. The end cap is used with the Cisco 3270 Rugged Enclosure or the Cisco 3230 Rugged Enclosure. The antenna ports are connector type RP-TNC. Each RP-TNC is connected internally to a WMIC. Typically, two antenna ports are used to support each WMIC. If fewer than three WMICs are installed, the unused antenna connector ports are sealed with a cap to protect them from the environment.

Figure 1-6 Cisco 3200 Rugged Enclosure Antenna End Cap with a Mounting Bracket



Note By default, the Cisco 3205 WMIC uses the right antenna to receive and transmit data.

Note For additional information on antennas and antenna cables, see the "Antenna Basics" technical note at http://www.cisco.com/en/US/products/hw/wireless/ps458/products_installation_guide_chapter09186a008007f74a.html
and the "Antenna Cabling" technical note at
http://www.cisco.com/en/US/tech/tk722/tk809/technologies_tech_note09186a00801c12c2.shtml

I/O End Caps for the Cisco 3200 Rugged Enclosures

The I/O end cap has multiple connectors for connecting power and data cables. The end cap configurations shown in this section are fully populated; however, the number of ports and their functions may differ, depending upon the number of WMICs in the system.

End Cap Fast Ethernet and WMIC Console Ports

Internally, five Fast Ethernet ports are available: one routed Fast Ethernet port on the router card and four switched Fast Ethernet ports on the Fast Ethernet Switch Mobile Interface Card (FESMIC). When a WMIC is installed in addition to the router, the WMIC Fast Ethernet port is connected internally to the routed Fast Ethernet port on the router card or is connected to one of the switched Fast Ethernet ports on the FESMIC to provide a communications link with the router. In contrast, the Serial Mobile Interface Card (SMIC) and FESMIC communicate with the router through the bus. All the router Fast Ethernet ports are addressed by using the slot/port format.

In typical configurations, the first WMIC Fast Ethernet port is connected to the routed Fast Ethernet port on the router card. The Fast Ethernet ports of the second and third WMICs are connected to FESMIC switched Fast Ethernet ports. The differences in the types of the router Fast Ethernet ports that the WMICs are connected to affect how they are configured, as, for example, when uploading a Cisco IOS image to a WMIC.

The WMIC runs an independent Cisco IOS image and when you configure the WMIC, the link forms an internal LAN. In standard configurations, the WMIC Fast Ethernet port is never brought out to the end cap.

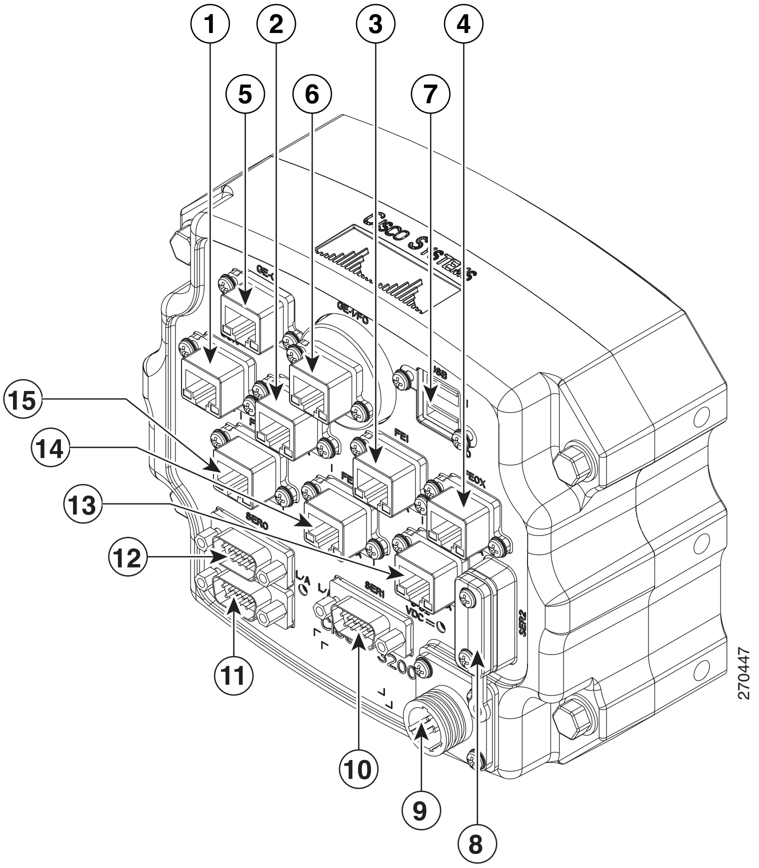
The WMIC console port is brought out to the corresponding RJ-45 port on the I/O end cap, replacing a Fast Ethernet port. If the router includes one WMIC, the EIA/TIA-232 WMIC console port replaces a Fast Ethernet port on the end cap. If the router includes two WMICs, two WMIC EIA/TIA-232 console ports replace two Fast Ethernet ports on the end cap.

Note At present, even if the router contains no WMICs, in standard configurations the maximum three Fast Ethernet ports are brought out to the end cap. Unused EIA/TIA-232 ports are sealed.

Cisco 3270 Router I/O End Cap

Figure 1-7 shows the Cisco 3270 Router I/O end cap.

Figure 1-7 Cisco 3270 Router End Cap



1	Router console port	**2**	FE0 port
3	FE1 port	**4**	FE0X port
5	GE0 (Gigabit Ethernet) port	**6**	Fiber-Optic port (shown) or Copper Gigabit Ethernet (GE1) port
7	USB0 (bottom) and USB1 (top) ports	**8**	Ser2 Smart Serial port
9	Power input	**10**	Ser1 EIA/TIA-232 (DCE) port
11	AUX port	**12**	Ser0 EIA/TIA-232 (DCE) port
13	FE1X port or WMIC 3 console port[1]	**14**	FE2X port or WMIC 2 console port[1]
15	FE3X port or WMIC 1 console port[1]		

[1] The configuration of the port is set at the factory and labeled accordingly.

The RJ-45 connectors identified as 8, 9, and 10 are Fast Ethernet ports or WMIC console ports, depending on the configuration of the system. For example, if two WMICs have been added to the router, RJ-45 ports 8 and 9 are labeled WMIC 1 and WMIC 2. Port 10 is labeled FE1X.

Note The connectors are sealed at the factory with captive dust covers (not shown) that seal the ports and protect the pins. The dust covers should be used to seal the ports when the ports are not covered by cable connectors.

Fiber Optic Connector IP–67 Integrity

When the fiber-optic port is not connected or otherwise in use, the protective cover should be used to seal the port. To seal the fiber-optic port when it is connected to a cable, use connectors that maintain IP-67 integrity. The part numbers for the connectors are Tyco 1828618–1 and Tyco 1828618–2.

Caution When connecting fiber-optic cables, observe all standard procedures for safety, and maintain a clean connection.

Power Connector IP-67 Integrity

To seal the Tyco DC Power input power connector and maintain IP-67 integrity, use the following parts:

- 796094-2–CPC housing
- 66101-3–contact
- 207489-1–boot
- 207490-1–cable (grip size 11)

Smart Serial Port External Seal for System Integrity

When the Smart Serial port is not connected or otherwise in use, the protective cover should be used to seal the port. To seal the Smart Serial port when the port is connected to a cable, complete the steps in Appendix A, “Smart Serial Port External Seal.” in the Cisco 3200 Series Router Hardware Reference.

USB Flash Storage Device Caveat

In some cases, using two USB flash storage devices causes unpredictable results (CSCsd11136).

If one USB flash storage device is plugged into a USB port and a second USB flash storage device is plugged into or unplugged from the other port, an error might occur (CSCsd44152). The error message is, "USB_HOST_STACK-6-USB_FLASH_READY_TEST_TIME: USB flash 'Ready' test time over 4 seconds."

If an unsupported USB flash storage device is plugged into a USB port, an error might occur (CSCsd44152). The error message is, "Failed to enumerate a USB device as not able to read the device's description."

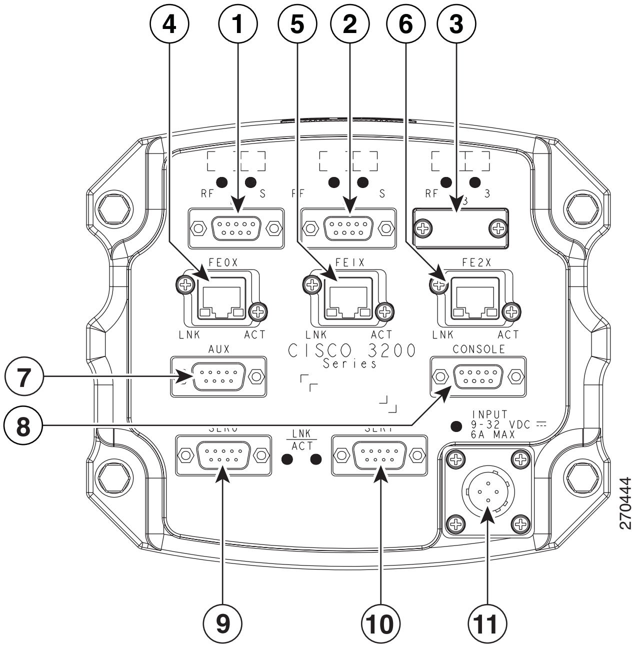
To correct the problems, remove any unsupported USB flash storage device and use only one supported device in one of the two USB ports. The Cisco-supported flash storage devices listed below.

Item#	Vendor	Part Number
16-3153-01	SANDISK	SDUJGU0-256-926
16-3153-01	M-SYSTEMS	8U-52E-0256-12A01C
16-3152-01	SANDISK	SDUJGU0-128-926
16-3152-01	M-SYSTEMS	8U-52E-0128-12A01C
16-3151-01	SANDISK	SDUJGU0-64-926
16-3151-01	M-SYSTEMS	8U-52E-0064-12A01C

Cisco 3230 Router I/O End Cap

Figure 1-8 shows the Cisco 3230 Router I/O end cap. It has multiple connectors that can be used to connect power and data cables.

Figure 1-8 Cisco 3230 Router End Cap



1	WMIC 1 console port	**2**	WMIC 2 console port
3	WMIC 3 console port	**4**	FE0 port
5	FE1X port	**6**	FE2X or MARC FE0X port (for more information, see the "Fast Ethernet Port Cabling for the Cisco 3250 and Cisco 3230 Routers" section on page 1-16.)
7	AUX port	**8**	Router console port
9	Ser0 RS-232 (DCE) port	**10**	Ser1 RS-232 (DCE) port
11	Power input		

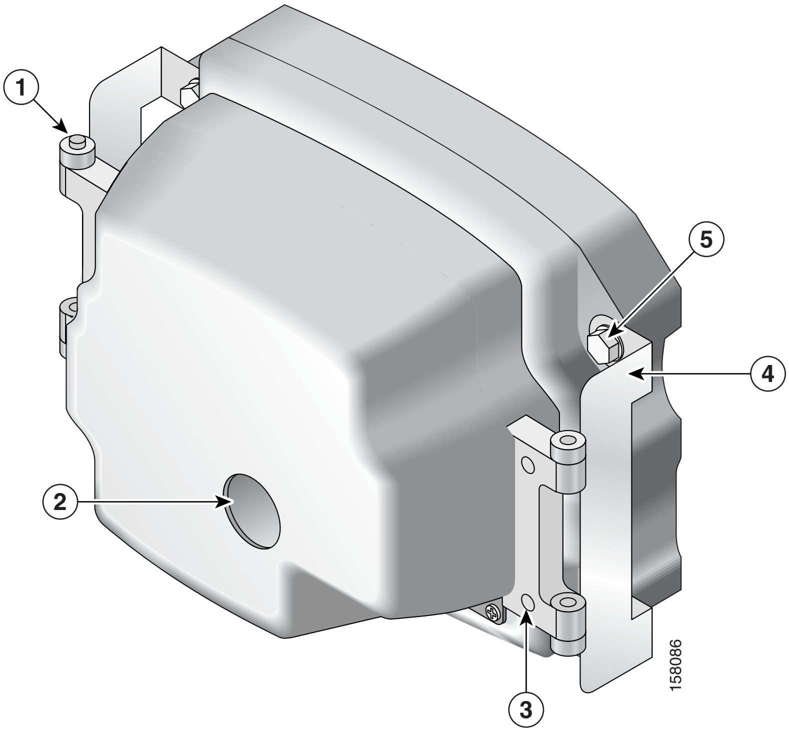
Note The connectors are sealed at the factory with captive dust covers (not shown) that seal the ports and protect the pins. The dust covers should be used to seal the ports when the ports are not otherwise covered by cable connectors.

Protective End Cap Cover

A protective end cap cover (Figure 1-9) provides weatherproof protection for the ports on the end caps of the Cisco 3200 Rugged Enclosure when the enclosure is installed outdoors. The protective end cap cover also provides added protection for in-vehicle use, inhibiting corrosion on the ports and potential damage from objects that are stored near the enclosure inside a vehicle.

The protective end cap cover has a ruggedized design for high reliability and NEMA4 compliance.

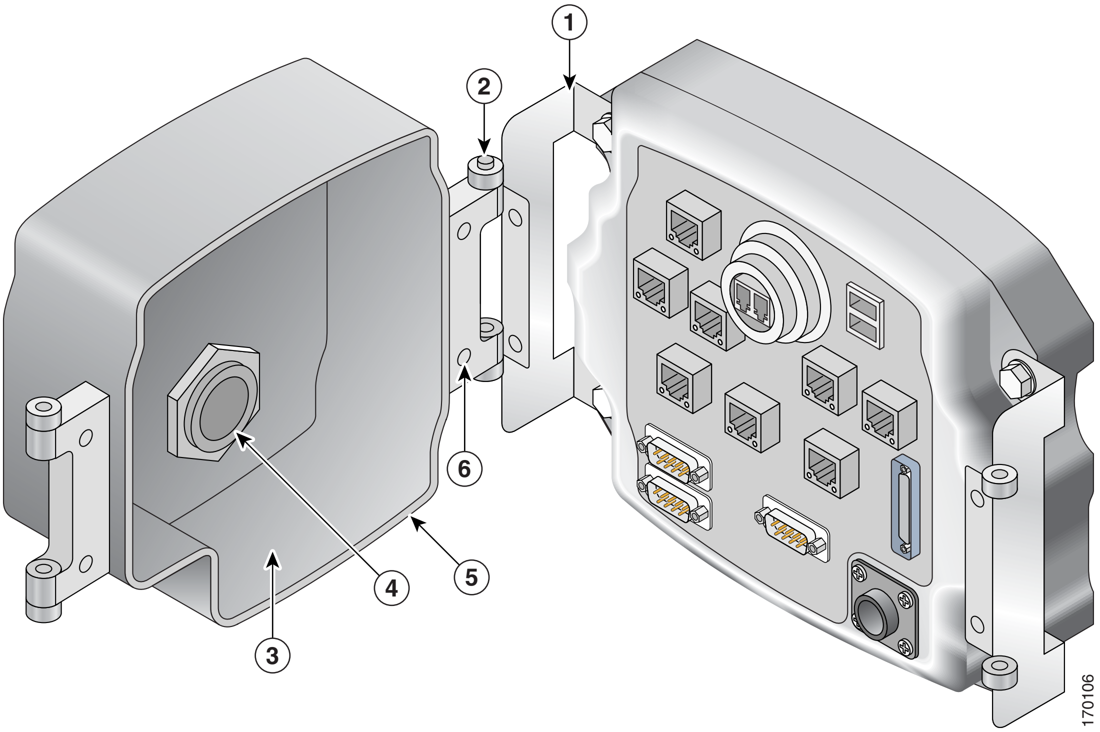
Figure 1-9 Cisco 3200 Rugged Enclosure Protective End Cap Cover



1	Hinge point	**2**	NEC cable pass-through
3	Holes for 8–32 protective end cap cover screws	**4**	Hinge/mounting bracket
5	Mounting bolt		

To attach the protective end cap cover to the enclosure, follow these steps (see Figure 1-10).

Figure 1-10 Protective End Cap Cover Installation



1	Hinge bracket	**2**	Hinge point
3	Cable/service loop cavity	**4**	NEC pass-through
5	Gasket	**6**	Cap mounting

Step 1 Loosen the end cap mounting hardware (four 1/4-20 bolts), but do not remove the bolts.

Step 2 Slide the hinge brackets onto the right side and the left side of the end cap cover. The mounting tabs should slide under the loosened bolts.

Step 3 Re-torque the two loosened bolts on the right side of the end cap cover to between 58 and 68 in-lb.

Step 4 Ensure that the gasket is fully seated in the protective end cap cover.

Step 5 Close the cover on the protective end cap cover and ensure that it is fully seated.

Step 6 Re-torque the end cap cover bolts on left side of the end cap cover to between 58 and 68 in-lb.

Step 7 Tighten the 8-32 protective cover screws (18 in-lb) until they are seated.

For sealing, we recommend Liquid Tight Connector, which is described at the following URL:

http://www.newark.com/NewarkWebCommerce/newark/en_US/mfr/brands.jsp?mfg=HUBB

I/O End Cap Port Signals

This section describes the ports and port signals on the Cisco 3200 Rugged Enclosure I/O end caps.

Gigabit Ethernet Signal Limitations

Due to CPU and memory bus limitations, a Gigabit Ethernet port transmits and receives packets below the line rate. The line rate is lower for small frames and higher for large frames.

Small packet streams on Gigabit Ethernet ports, such as 64-byte packet streams, support up to 24 percent of full duplex, bidirectional line rate traffic without experiencing packet drops.

The 512-byte packet streams support up to 78 percent of full duplex, bidirectional line rate traffic. The 1518-byte packet streams support up to 88 percent of full duplex bidirectional line rate traffic.

At higher frame rates the RDRP receive drop counter (displayed by using the **show controller** *g0/0* command) increases indicating dropped packets.

At higher frame rates for packet sizes greater than 512 bytes, the transmit underruns[1] counter (displayed by using the **show int** *g0/0* or **show int** *g0/1* command) increases. The transmit underruns might cause CRC errors on the peer router.

Fast Ethernet Signals

A Cisco router identifies a Ethernet port interfaces by slot number and port number in the format of slot/port. For example, the slot/port address of a Fast Ethernet interface on the Cisco 3230 Rugged Enclosure is 0/0.

The Cisco 3270 Router Ethernet port signals are in compliance with IEEE 802.3. The interfaces support the following:

- Autonegotiation and parallel detection MII interface with extended register capability for 10/100BASE-TX or 10/100/1000BASE-TX connections.
- Full-duplex and half-duplex modes.
- 3.3V operation low power consumption (300 mW typical).
- Low-power sleep mode.
- Robust baseline wander correction performance.
- MDIX support (Fast Ethernet and Gigabit Ethernet copper only).
- Jumbo Frame (4400 bytes) support on Gigabit Ethernet interfaces.
- 10BASE-T or 100BASE-TX using a single Ethernet connection.
- 10BASE-T, 100BASE-TX, or 1000BASE-TX using a Gigabit Ethernet copper connection.
- 100BAFX/100LX, 1000BASE-SX, 1000BASE-LX/LH for Gigabit Ethernet fiber-optic connections. (The speed is not configurable.)
- Standard carrier signal multiple access collision detect (CSMA/CD) or full-duplex operation.
- Integrated programmable LED drivers.

[1] Transmit underrun–an error on interfaces when the data is not ready on the memory bus when the system attempts to transmit the data; a bad packet is transmitted.

The Cisco 3230 Router Ethernet port signals are in compliance with IEEE 802.3. The interfaces support the following:

- Autonegotiation and parallel detection MII interface with extended register capability for 10/100BASE-TX connections
- Full-duplex and half-duplex modes
- 3.3V operation low power consumption (300 mW typical)
- Low-power sleep mode
- 10BASE-T or 100BASE-TX using a single Ethernet connection
- Robust baseline wander correction performance
- Standard carrier signal multiple access collision detect (CSMA/CD) or full-duplex operation
- Integrated programmable LED drivers

Fast Ethernet Port Cabling for the Cisco 3250 and Cisco 3230 Routers

Most Cisco 3200 Series router Ethernet ports support autodetection. If the device that the router is connected to also supports autodetection, the choice of a straight-through or crossover Ethernet cable does not matter. However, the Cisco 3250 router MARC FE0X port does not support autodetection.

To connect a port marked MARC FE0X to a routing Ethernet port that does not support autodetection, use a straight-through Ethernet cable. To connect a MARC FE0X port to a hub, switch, a router hub, or switch port, use a crossover Ethernet cable. Table 1-1 shows the connections.

Table 1-1 General Guidelines for MAR Fast Ethernet Port Cabling

Ports	Server, Workstation, or Personal Computer Ethernet Link	Hub, Switch, Uplink Router Ethernet Hub, or Switch
Ports marked FE0X, FE1X, and so forth	Straight-through cable	Crossover cable
Ports marked FE0, FE1, and so forth	Crossover cable	Straight-through cable

For example, a port marked FE0X requires a crossover Ethernet cable to establish the Ethernet link between a Cisco 3250 router and a hub. A port that does not support autodetection marked FE0 requires a straight-through Ethernet cable to establish the Ethernet link between a Cisco 3250 router and a hub.

For additional information on cable pin assignments, see the "Cable Pinouts" chapter of the *Cisco Content Services Switch Getting Started Guide* at:

http://www.cisco.com/en/US/products/hw/contnetw/ps789/products_installation_guide_chapter09186a00805f718d.html

Console Port Signals

You can connect to the router or to a Wireless Mobile Interface Card (WMIC) by using a console cable to connect to the console interfaces.

The console port signals:

- Are asynchronous serial DCE
- Support 9.6-kbps, 19.2-kbps, 38.4-kbps, 57.6-kbps, and 115.2-kbps baud rates
- Support full modem control of DTR, DSR, RTS, and CTS signals

AUX Port Signals

The AUX port is a serial asynchronous port that supports the following speeds:

- Cisco 3270 Rugged Router card in the Cisco 3270 Router: 1.2 kbps, 2.4 kbps, 4.8 kbps, 9.6 kbps, 19.2 kbps, 38.4 kbps, 57.6 kbps, 115.2 kbps, and 460 kbps.
- Mobile Access Router Card (MARC) in the Cisco 3230 Router: 1.2 kbps, 2.4 kbps, 4.8 kbps, 9.6 kbps, 19.2 kbps, 38.4 kbps, 57.6 kbps, and 115.2 kbps.

The AUX port supports the following:

- Asynchronous serial DTE
- 5 to 8 data bits
- 1, 1.5, or 2 stop bits
- Odd, even, or no parity
- Flow control by using RTS, CTS, DTR, and CDC signals

Cisco 3200 Rugged Enclosure LED Indications

This section describes the LED indications for the Cisco 3200 Rugged Enclosure I/O end caps.

Note The behavior of the WMIC LEDs is described in the "WMIC Console LEDs" section on page 1-19.

Cisco 3270 Rugged Enclosure I/O End Cap LED Indications

Table 1-2 lists the LEDs for the Cisco 3270 Rugged Enclosure I/O end caps and their indications.

Table 1-2 LEDs for the Cisco 3270 Rugged Enclosure End Cap

LED	Indication
Cisco 3270 Rugged Router card	Solid green: OK. Blinking: Booting and self-testing. Black: Not OK or the power is off.
Serial Status/Link (1 status/link LED per serial port)	Solid green: Link OK. Black: No link is detected. Amber blink: Activity.
Fast Ethernet (1 LED per port, except for the fiber-optic port, which has no LEDs)	**Link LED** Solid green: Link OK. Black: No link is detected. **Activity LED** Black: No activity and no connection. Green blink: Activity.
Gigabit Ethernet (2 LEDs per port)	**Link LED** Solid green: Link OK. Black: no link is detected. **Activity LED** Solid green: Link OK. Black: No activity. Green blink: Activity.
Console	Solid green: Link OK. Black: No activity. Green blink: Activity.
WMIC Console (Installation or Operation Mode)	For installation mode, see Table 1-4 on page 1-19. For operation mode, see Table 1-5 on page 1-20.

Cisco 3230 Rugged Enclosure I/O End Cap LED Indications

Table 1-3 lists the LEDs for the Cisco 3230 Rugged Enclosure I/O end caps and their indications.

Table 1-3 LEDs for Cisco 3230 Router I/O End Caps

LED	Indication
MARC	Solid green: OK. Blinking: Booting and self-testing. Black: Not OK or the power is off.
Serial Status/Link (1 status/link LED per serial port)	Solid green: Link OK. Black: No link is detected. Amber blink: Activity.
Fast Ethernet (2 LEDs per Fast Ethernet port)	**Link LED** Solid green: Link OK. Black: No link is detected. **Activity LED** Black: No activity. Green blink: Activity.
WMIC Console (Installation or Operation Mode)	For installation mode, see Table 1-4 on page 1-19. For operation mode, see Table 1-5 on page 1-20.

WMIC Console LEDs

WMIC console LEDs function in installation mode or operational mode. The WMIC is set to the installation mode by default. To change the function of the WMIC, use the **station role** command.

Table 1-4 shows the status of the LEDs when the WMIC is in installation mode (signal strength).

Table 1-4 WMIC Installation Mode

RSSI (dBm)	Status LED	Radio LED
> –51	Steady	Steady
–58 to –54	Fast blinking (16 Hz)	Steady
–60 to –57	Slow blinking (4 Hz	Steady
–63 to –60	Very slow blinking (2 Hz)	Steady
–66 to –63	Black	Steady
–69 to –66	Black	Fast blinking (16 Hz)
–72 to –69	Black	Slow blinking (4 Hz
–75 to –72	Black	Very slow blinking (2 Hz)
< –75	Black	Black

Table 1-5 shows the status of the LEDs when the WMIC is in operational mode.

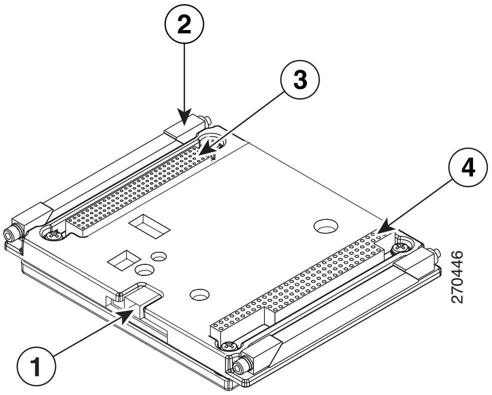
Table 1-5 WMIC Operational Mode

Indication	Status LED	Radio LED
Green steady	At least one bridge is associated.	—
Red steady	Loading firmware.	Firmware failure.
Green blink	No bridges are associated.	Transmitting or receiving packets on the radio port.
Amber blink	General warning.	Maximum retries or buffer full.
Black (no light)	—	Default.

Thermal Plates

Cisco 3200 Rugged Enclosures use thermal plates and Wedge Loks to transfer heat from the cards to the extrusion. Figure 1-11 shows a card with thermal plates. The conduction cooling removes the need for internal fans.

Figure 1-11 Router Card with Thermal Plates



1	Power connector	**2**	Wedge Lok
3	ISA bus	**4**	PCI bus

Mounting Brackets

Mounting brackets are available for the enclosures.

The notches in the mounting brackets allow you to temporarily install the bracket without the router in place. The bolts for the notches in the mounting bracket can be installed on the enclosure before the other bolts are installed. The partially installed bolts provide enough support to allow you to install the router in the bracket, and then install and tighten the remaining bolts. The torque values for the mounting bracket screws are from 58 to 68 in-lb.

Figure 1-12 shows the Cisco 3270 Rugged Enclosure mounting bracket.

Figure 1-12 Cisco 3270 Rugged Enclosure Mounting Bracket

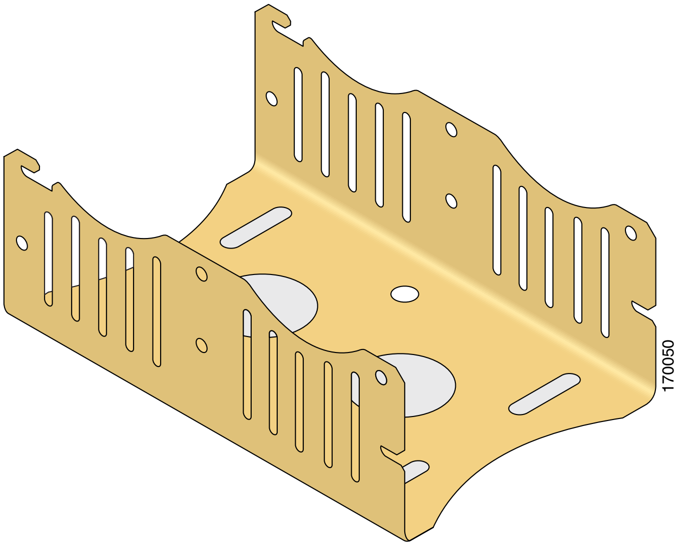


Figure 1-13 shows the dimensions of the Cisco 3270 Rugged Enclosure mounting bracket.

Figure 1-13 Cisco 3270 Rugged Enclosure Mounting Bracket Dimensions

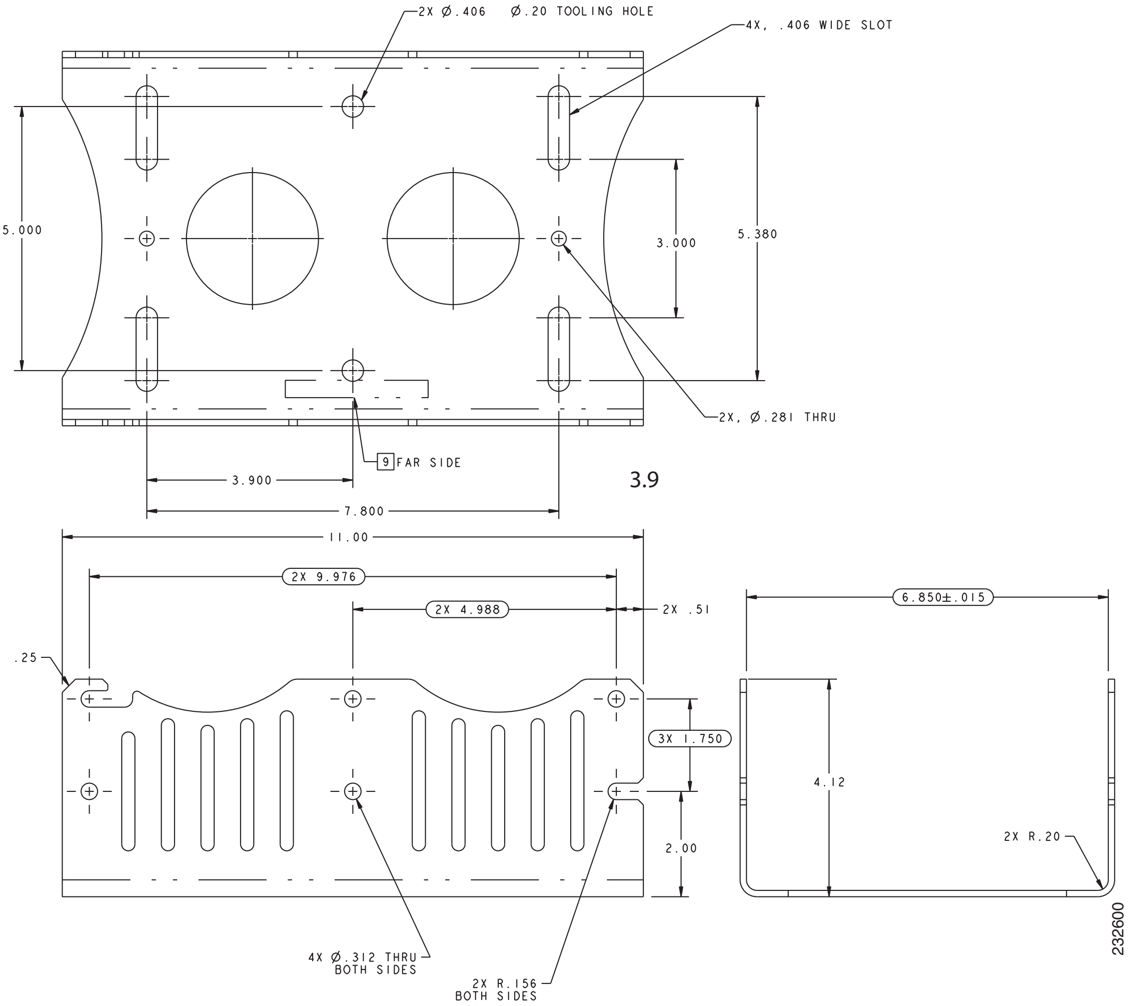


Figure 1-14 shows the Cisco 3230 Rugged Enclosure mounting bracket.

Figure 1-14 Cisco 3230 Rugged Enclosure Mounting Bracket

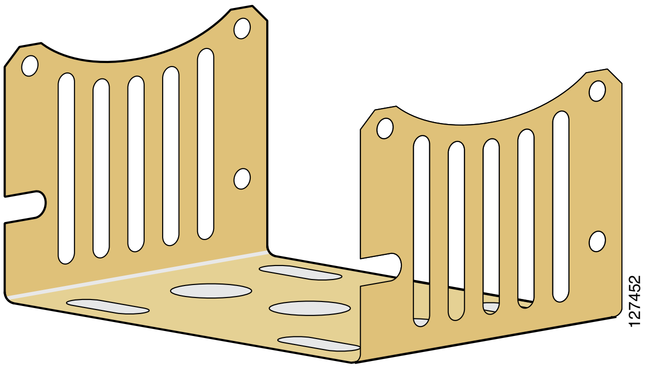
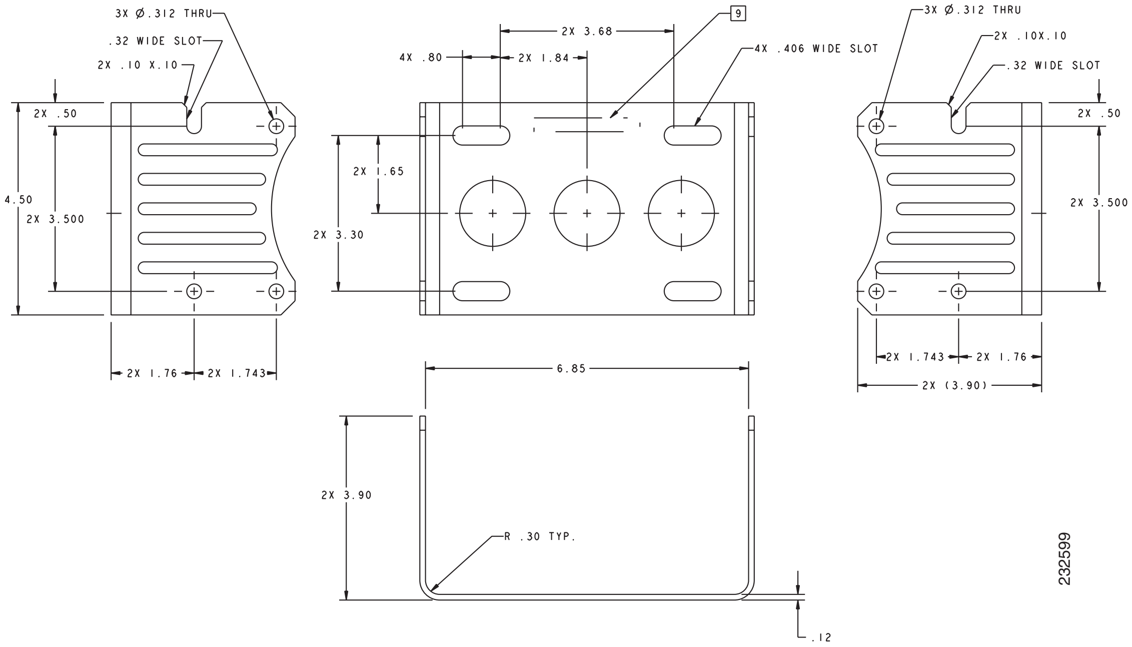


Figure 1-15 shows the dimensions of the Cisco 3230 Rugged Enclosure mounting bracket.

Figure 1-15 Cisco 3230 Rugged Enclosure Mounting Bracket Dimensions



CHAPTER 2

Cisco 3270 Rugged Router Card

This chapter describes the features of the Cisco 3270 Rugged Router card. The Cisco 3270 Rugged Router card is the core component of a Cisco 3270 Mobile Access Router. It is compatible with other Cisco 3200 Series router mobile interface cards (MICs), such as the Wireless Mobile Interface Card (WMIC). The Cisco 3270 Rugged Router card is also available as a standalone router card (to be embedded into a third-party enclosure).

The Cisco 3270 Rugged Router card includes the host processor, memory, ports, and LED signals. Additional components provide power and link interfaces; for example, the Serial Mobile Interface Card (SMIC) provides the serial interfaces. The exact configuration of your router will vary, depending on how the device was configured by the vendor.

The Cisco 3270 Rugged Router card has the following features:

- Support for the PC/104-*Plus* form factor.
- Dual 32-bit PCI buses, one running at 66 MHz and the other at 25 MHz.
- 256-MB, 64-bit, unbuffered, double data rate (DDR), synchronous DRAM.
- 64-MB, 16-bit flash memory.
- Two Fast Ethernet ports with autonegotiation.
- Two Gigabit Ethernet port signal sets with autonegotiation; the router can be ordered with support for one fiber-optic port and one copper port, or with two copper ports.
- Console port signals, with modem flow control.
- Asynchronous EIA/ITA 232 serial port signals with 5V auxiliary power for GPS/AUX devices.
- Two USB 2.0 high-speed (480-Mbps) port signal sets.
- High-performance hardware encryption processor.
- Zeroization to clear up any trace of user data or binary code.
- Industrial-grade components that support local component ambient temperature ranges.[1]
- An enhanced PCI-to-PCI bridge that supports asynchronous operation. The asynchronous bridge allows each port to run from a separate independent clock for the highest performance. A synchronous clock forces one side of the bridge to slow down to support a slow device on the other side of the bridge; asynchronous bridge clock domains can be arbitrarily different.

[1] Except optical small form-factor pluggable (SFP) modules. Optical SFPs have a temperature range of -40 to +85°C *device temperature* as opposed to *local component ambient temperature*.

Note The Cisco 3270 router can be ordered with one Gigabit Ethernet copper interface and one fiber optic interface, or with two Gigabit Ethernet copper interfaces. The port configurations are not interchangeable.

The PCI bus connector supports communication between the Serial Mobile Interface Card (SMIC), the Fast Ethernet Switch Mobile Interface Card (FESMIC), and the Cisco 3270 Rugged Router card. The Wireless Mobile Interface Card (WMIC) communicates with the router through an internal Fast Ethernet port. The WMIC is configured through an independent console port; the card draws power only from the bus.

Note For detailed information about the Cisco 3270 Rugged Router card, such as header pin assignments, see the "Cisco 3200 Series Mobile Access Router Technical Reference" (OL-1927). This book is a controlled document. Qualified system integrators can contact Cisco Marketing to receive a copy.

Cisco 3270 Rugged Router Card Component Systems

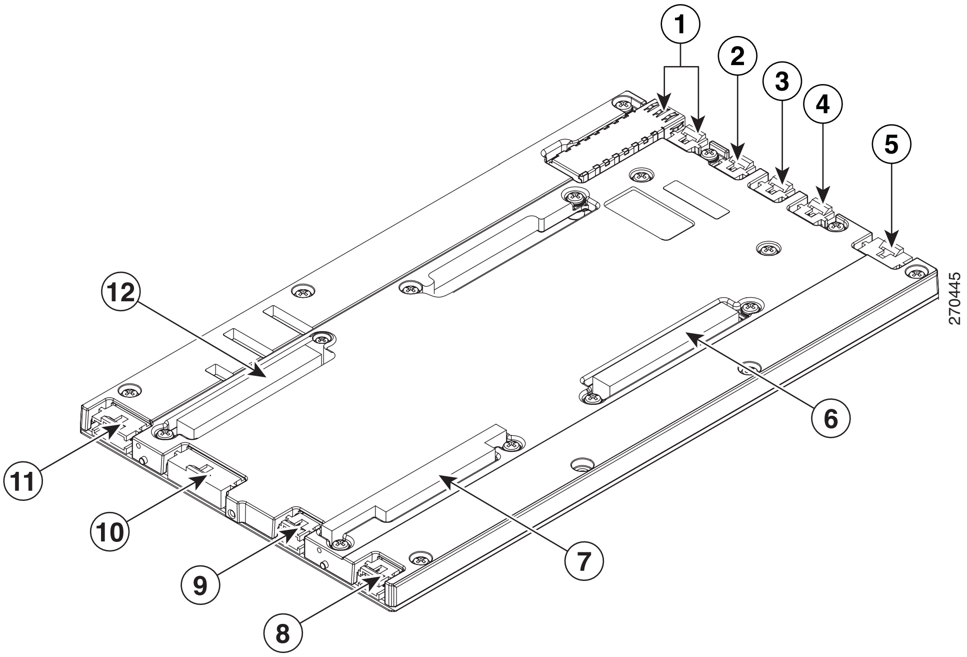
The industry-standard architecture (ISA) buses and peripheral component interconnect (PCI) buses on the Cisco 3200 Series Mobile Access Router cards provide power to the components on the cards. Both buses comply with the PC/104-*Plus* standard. The ISA bus allows PC/104-*Plus* ISA signals to pass through the card bus, but the Cisco cards do not use any of the signals.

The PCI bus signals allow the Cisco SMIC and FESMIC to communicate with the Cisco 3270 Rugged Router card. The WMIC draws power from the bus, but it does not communicate with the router through the buses. It communicates with the router through an internal Fast Ethernet port. Non-Cisco cards cannot communicate with the router over the PCI bus.

Caution If you add non-Cisco cards that generate signals on the PCI bus, the router might shut down. Please do not add non-Cisco cards that generate signals on the PCI bus.

Figure 2-1 shows the Cisco 3270 Rugged Router card header and bus locations.

Figure 2-1 Cisco 3270 Rugged Router Card Header and Bus Locations



1	Gigabit Ethernet 1 (fiber-optic or copper)	**2**	Gigabit Ethernet 0
3	Fast Ethernet 1	**4**	Fast Ethernet 0
5	USB ports and USB LEDs	**6**	PCI bus for future expansion
7	ISA bus	**8**	Jumper for optional Fast Ethernet 0[1]
9	Optional Fast Ethernet 0	**10**	Multifunction (AUX, console, LED) header
11	GPIO[2] Zeroization pins and USB header	**12**	PCI bus

[1] Factory set. Do not modify.

[2] General Purpose Input/Output.

Note The PC/104-*Plus* standard requires that the PCI bus and the ISA bus use keying features in the standard stacking headers to guarantee proper module installation. On the PCI bus, pin D30 is removed and the D30 opening is plugged. On the ISA bus, pin C19 and pin B10 are removed, and the C19 and B10 openings are plugged.

Cisco 3270 Rugged Router Card Power Requirements

The Cisco 3270 Rugged Router card uses +3.3 V, +5 V, and +12 V power sources. Typical power consumption is 20 W. The maximum calculated wattage is 26.5 W.

Table 2-1 Cisco 3270 Rugged Router Card Voltages

Voltage	Current	Power
+3.3 V	1.8 A	5.9 W
+5.0 V	4.0 A	20.0 W
+12.0 V	0.05 A	0.6 W

Power Connections (AUX)

The speed of the AUX port for the Cisco 3270 Rugged Router card can be configured as 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, or 460800 bps. Use the **line aux** *linenumber speed* command to modify the speed of the port.

A +5V power supply is provided for devices connected to the AUX port. A Global Positioning System (GPS) modem is used as an example in this section. Typically the +5V power supply current to GPS modems should be limited to less than 200 mA.

Table 2-2 shows the pin assignments for power on the AUX port.

Table 2-2 Cisco 3270 Rugged Router Card Multifunction Header Pin Assignments for Power

Pin	Signal	Description	Function
9	GND	Ground	GND
26	+5 V	+5 V DC Power Supply	Power

Hardware Encryption Processor

The Cisco 3270 Rugged Router card integrated security engine (SEC 2.0) is optimized to handle all the algorithms associated with IPSec, Secure Sockets Layer (SSL)/Transport Layer Security (TLS), Secure Real-time Transport Protocol (SRTP), 802.11i, Internet SCSI (iSCSI), and Internet key exchange (IKE) processing. The security engine contains four crypto channels, a controller, and a set of crypto execution units (EUs).

The SEC can act as a master on the internal bus. This allows the SEC to alleviate the data movement bottleneck normally associated with slave-only cores. The host processor accesses the SEC through its device drivers, using system memory for data storage. The SEC resides in the peripheral memory map of the processor; therefore, when an application requires cryptographic functions, it creates descriptors for the SEC that define the cryptographic function to be performed and the location of the data.

The SEC bus-mastering capability permits the host processor to set up a crypto channel with a few short register writes, leaving the SEC to perform reads and writes on system memory to complete the required task.

The EUs are:

- Public Key Execution Unit (PKEU) supporting:
  - RSA and Diffie-Hellman
  - Programmable field size up to 2048 bits
  - Elliptical curve cryptography
- Data Encryption Standard Execution Unit (DEU)
  - Data Encryption Standard (DES)
  - Triple Data Encryption Standard (3DES)
  - Two-key (K1, K2) or three-key (K1, K2, K3)
  - Ethernet Bundling Controller (EBC) and Cipher Block Chaining (CBC) modes for both DES and 3DES
- Advanced Encryption Standard Unit (AESU)
  - Implements the Rinjdael symmetric key cipher
  - Key lengths of 128, 192, and 256 bits
  - ECB, CBC, CCM, and AES Counter Mode (a block cipher that encrypts 128-bit blocks of data at a time with a 128-bit encryption key)
- ARC Four execution unit (AFEU)
  - A stream cipher compatible with the RC4 algorithm
  - 40- to 128-bit programmable key
- Message Digest Execution Unit (MDEU)
  - Secure Hash Algorithm (SHA) with a 160-bit or 256-bit message digest
  - Message Digest 5 (MD5) with a 128-bit message digest
  - Hash-based Message Authentication Code (HMAC) with either algorithm
- Random Number Generator (RNG)
- Four crypto channels, each supporting multi command descriptor chains
  - Static or dynamic assignment of crypto-execution units through an integrated controller
  - Buffer size of 256 bytes for each EU, with flow control for large data sizes

Caution Zeroization is a feature that erases all potentially sensitive information from the router. It is disabled by default on the router. When Zeroization is not configured on the router, the AUX port functions as a modem port or a terminal port.

Zeroization is *configured* through the command-line interface (CLI), but it cannot be *activated* through the CLI. Zeroization is activated by actuating a custom switch connected to the GPIO pins or an actuator (such as a push button) that must be attached to the AUX port.

There is no way for the router to reliably determine whether a device attached to the AUX port is an actuator. Therefore, any device attached to the AUX port could potentially trigger declassification. When declassification is enabled through the CLI, we recommend that you do not use the AUX port for any function other than declassification.

Ethernet Port Speed and Duplex Mode

The router cannot automatically negotiate port speed and duplex mode unless the connecting port is configured **speed auto**, **duplex auto**, or **no speed**. If the port speed is set to a value other than **auto**, such as 10, 100, or 1000-Mbps, configure the remote link partner port to match the local settings; do not configure the link partner port to **auto**.

If a copper Gigabit Ethernet port speed is configured as 1000-Mbps, it must be configured as **duplex auto** mode; otherwise the link will not come up. We recommend that you use the **speed auto** command and **duplex auto** command to configure a Gigabit Ethernet port.

The fiber-optic Gigabit Ethernet port does not allow users to configure the mode as speed or duplex. The port speed and mode are determined by the SFP module.

Note Changing the Ethernet port speed and duplex mode configuration might shut down and reenable the interface during the reconfiguration.

The procedure to set the port speed for a copper Gigabit Ethernet port is as follows:

	Command	Purpose
Step 1	Router(config)# **interface GigabitEthernet** *slot*/*port*	Selects the Ethernet port to be configured.
Step 2	Router(config-if)# **speed** {**10** | **100** | **1000** | **auto**}	Sets the speed of the Ethernet interface.
Default	Router(config-if)# **no speed**	Reverts to the default configuration (**speed auto**). If you set the port speed to auto on a 10/100/1000-Mbps Ethernet port, speed is autonegotiated.

To set the mode on a copper Gigabit Ethernet port to duplex?

	Command	Purpose
Step 1	Router(config)# **interface GigabitEthernet** *slot*/*port*	Selects the Ethernet port to be configured.
Step 2	Router(config-if)# **duplex** [**auto** | **full** | **half**]	Sets the duplex mode of the Ethernet port.
Default	Router(config-if)# **no duplex**	Reverts to the default configuration (**duplex auto**).

Note The Gigabit Ethernet optical fiber interface only supports full duplex mode; a Cisco IOS command to set the mode is not is supported.

Cisco 3270 Rugged Router Card Encryption Module

The integrated security engine (SEC 2.0) is optimized to handle all the algorithms associated with IP security (IPSec), Secure Sockets Layer (SSL)/Transport Layer Security (TLS), Secure Real-time Transport Protocol (SRTP), 802.11i, Internet Small Computer System Interface (iSCSI), and Internet Key Exchange (IKE) processing. The security engine contains four crypto channels, a controller, and a set of crypto execution units (EUs). The security engine can act as a master on the internal bus. This allows the security engine to alleviate the data movement bottleneck normally associated with slave-only cores.

The host processor accesses the security engine through device drivers, using system memory for data storage. The security engine resides in the peripheral memory map of the processor; therefore, when an application requires cryptographic functions, it simply creates descriptors for the security engine that define the cryptographic function to be performed and the location of the data.

The security engine bus-mastering capability permits the host processor to set up a crypto-channel with a few short register writes, leaving the security engine to perform reads and writes on system memory.

Security Engine Features

The execution units are:

- Public Key Execution Unit (PKEU) supporting the following:
  - RSA and Diffie-Hellman
  - Programmable field size up to 2048 bits
  - Elliptic curve cryptography
- Data Encryption Standard Execution Unit (DEU)
  - DES, 3DES
  - Two key (K1, K2) or Three Key (K1, K2, K3)
  - Electronic codebook (ECB) and cipher-block chaining (CBC) modes for both DES and 3DES
- Advanced Encryption Standard Unit (AESU)
  - Implements the Rinjdael symmetric key cipher
  - Key lengths of 128, 192, and 256 bits
  - ECB, CBC, Counter with CBC-MAC (CCM), and Counter modes
- ARC Four execution unit (AFEU)
  - Implements a stream cipher compatible with the RC4 algorithm
  - 40- to 128-bit programmable key
- Message Digest Execution Unit (MDEU)
  - SHA-1 with 160-bit or 256-bit message digest
  - MD5 with 128-bit message digest
  - Keyed-Hash Message Authentication Code (HMAC) with either SHA or MD5 algorithm (HMAC-MD5 or HMAC-SHA)
- Random Number Generator (RNG)

- 4 crypto channels, each supporting multicommand descriptor chains
  - Static and/or dynamic assignment of crypto execution units through an integrated controller
  - Buffer size of 256 bytes for each execution unit, with flow control for large data sizes
- 256 (PBGA), 17x17 in., typical power 1.7 W

Temperature Sensor

A router equipped with the Cisco 3270 Rugged Router card includes a high-precision digital thermometer and thermostat (DS1631). The temperature is sampled every 30 seconds. A warning is sent to users by means of SNMP traps and by flashing the overtemperature LED if temperature falls below -40ºC or exceeds +95ºC until the temperature falls back to its normal range.

Note The signal and LED are available only on the Cisco 3270 Rugged Router card, not on the Cisco 3200 rugged enclosures.

Cisco 3270 Rugged Router Card MAC Address Allocation

Cisco 3270 Rugged Router card–equipped routers are allocated 37 MAC addresses, starting from the base MAC address. A card-equipped Cisco 3270 Rugged Router supports four interface ports. Fast Ethernet ports can be port 0 and 1. Gigabit Ethernet ports are port 2 and 3, depending on the router configuration.

The assignments for MAC addresses are as follows:

- Four MAC addresses for each of the for four Ethernet ports, offset 0 to 3 from the base MAC address.
- One switch virtual interface (SVI) for the FESMIC; offset 4 from the base MAC address.
- Thirty-two MAC addresses for FESMIC Spanning Tree Protocol (STP), offset 5 to 36 from the base MAC address.

CHAPTER 3

Mobile Access Router Card

The Mobile Access Router Card is one component of the Cisco 3200 Series Mobile Access Router. It includes the host processor, memory, and headers for the Fast Ethernet, console, and auxiliary signals for the router. Additional components provide power and link interfaces to the MARC. For example, the 4-port Serial Mobile Interface Card (SMIC) provides up to four Smart Serial interfaces. The exact configuration of your router will vary, depending on how your vendor configured it.

Note This section provides basic information about the MARC hardware for the purpose of performing simple troubleshooting tasks, such as reconnecting a loose cable. To solve more difficult problems, please contact your vendor.

The key features of the MARC include the following:

- MPC8250 processor running 210 MHz at the CPU core, 150 MHz at the CPM core, and 60 MHz on the Motorola 60x bus.
- 32 MB of flash memory.
- 128 MB of synchronous DRAM.
- 10/100 Fast Ethernet, full-duplex connection with autonegotiation.
- Console connection with hardware/software flow control.
- Asynchronous, EIA/TIA-232 serial connection with a 5 V auxiliary power supply for Global Positioning System (GPS) and auxiliary (AUX) devices.
- The AUX port speed can be configured as 2400, 4800, 9600, 19200, 38400, 57600, or 115200 bps. Use the **line aux** *linenumber speed* command to modify the speed of the port.
- A 32-bit PCI bus, version 2.1, running at 25 MHz.
- Supports Zeroization when this featured is configured on the router.

Caution Zeroization is a feature that erases all potentially sensitive information from the router. Zeroization is configured through the command-line interface (CLI) and activated through an actuator attached to the AUX port, such as a push button. Zeroization is disabled by default on the Cisco 3200 Series router.

When Zeroization is not configured on the router, the AUX port functions as a modem port or a terminal port. When declassification is enabled through the CLI, we recommend that you do not use the AUX port for any other function than declassification. This is because there is no way for the router to reliably determine if a device attached to the AUX port is an actuator; therefore, any device attached to the AUX port could potentially trigger declassification.

The PCI bus connector supports communication between the Serial Mobile Interface Card (SMIC), the Fast Ethernet Switch Mobile Interface Card (FESMIC), and the Mobile Access Router Card. The Wireless Mobile Interface Card (WMIC) communicates with the router through an internal Fast Ethernet port and is configured through an independent console port; the WMIC only draws power from the bus.

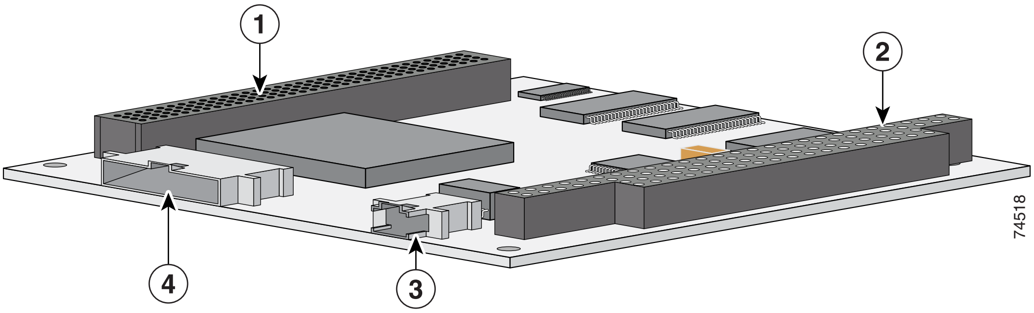
MARC Component Systems

The industry-standard architecture (ISA) buses and peripheral component interconnect (PCI) buses on the Cisco 3200 Series Mobile Access Router cards provide power to the components on the cards. Both buses comply with the PC/104-*Plus* standard. The ISA bus allows PC/104-*Plus* ISA signals to pass through the card bus, but the Cisco cards do not use any of the signals.

Caution If you add non-Cisco cards that generates signal on the PCI bus, the router might shut down. Please do not add non-Cisco cards that generate signals on the PCI bus.

Figure 3-1 shows the MARC header and bus locations.

Figure 3-1 MARC Header and Bus Locations



1	PCI bus	**2**	ISA bus
3	Ethernet header	**4**	Multifunction header

Note The PC/104-*Plus* standard requires that the PCI Bus and the ISA bus use keying features in the standard stacking headers to guarantee proper module installation. On the PCI bus, pin D30 is removed and the D30 opening is plugged. On the ISA bus, pin C19 and B10 are removed, and the C19 and B10 openings are plugged.

MARC Power Requirements

The MARC uses +3.3-V, +5-V, and +12-V power sources. Internal on-board DC-to-DC conversion circuitry generates 1.8 V/1.5 A from the +3.3-V power source.

Table 3-1 MARC *Voltages*

Voltage	Current	Power
+5.0 V	0.3 A	1.5 W
+12.0 V	0.1 A	1.2 W
+3.3 V	2.0 A	6.6 W

MARC Router Signals

Cisco 3200 Series router cards do not support any ISA bus signals. The PCI bus connector supports communication between Cisco 3200 Series Mobile Access Router cards.

Note Non-Cisco MIC cards cannot use PCI signals. The use of PCI signals by non-Cisco cards causes unpredictable results. You cannot add third-party devices that might attempt to communicate with the SMIC through the ISA or PCI bus.

The signals are delivered through the shared, 34-pin multifunction header and the 10-pin Ethernet header. LED signals and 5 V of power are also provided through the shared, 34-pin multifunction header.

Fast Ethernet Signals on the MARC

There is one fixed Fast Ethernet port on the MARC. A Cisco router identifies a Fast Ethernet interface address by its slot number and port number, in the format slot/port. The slot/port address of a Fast Ethernet interface on the MARC is 0/0.

The Fast Ethernet port signals are in compliance with IEEE 802.3. They are provided through the 10-pin Ethernet header, which supports the following:

- Autonegotiation and parallel detection MII interface with extended register capability for 10/100BASE-TX connection
- Full-duplex and half-duplex modes
- 3.3-V operation low power consumption (300 mW typical)
- Low-power sleep mode
- 10BASE-T and 100BASE-TX using a single Ethernet connection
- Robust baseline-wander correction performance
- 100BASE-FX fiber-optic capabilities
- Standard carrier signal multiple access collision detect (CSMA/CD) or full-duplex operation
- Integrated, programmable LED drivers

The FastEthernet 0/0 port on the MARC is a Fast Ethernet *router* port. The FastEthernet ports on the 4-port FESMIC and the 2-port FESMIC are Fast Ethernet *switch* ports. The routing features supported on the MARC cannot be configured on the FESMIC ports.

Console and Auxiliary Signals

You can configure the console interface by using Cisco IOS command line interface (CLI) commands. The console interface and the AUX port can be accessed simultaneously. Also, the console port and the AUX port can be accessed simultaneously. For example, you can connect a terminal to the console interface and an external modem or a GPS modem to the AUX port.

The console port signals are provided through the multifunction header:

- Asynchronous serial DCE
- 1.2-kbps, 2.4-kbps, 4.8-kbps, 9.6-kbps, 19.2-kbps, 38.4-kbps, 57.6-kbps, and 115.2-kbps baud rates
- Support full modem control DTR, DSR, RTS, and CTS signals

The AUX port is a serial asynchronous port that works at speeds of 1.2 kbps, 2.4 kbps, 4.8 kbps, 9.6 kbps, 19.2 kbps, 38.4 kbps, 57.6 kbps, and 115.2 kbps.

The AUX port supports the following:

- Asynchronous serial DTE
- Baud rates range from 1,200 to 115,000
- 5 to 8 data bits
- 1, 1.5, or 2 stop bits
- Odd, even, or no parity
- Flow control by using RTS, CTS, DTR, and CDC signals

Note When zeroization is enabled, it is activated through the polling of pin 25 on the AUX port.

A +5-V power supply is provided for a device connected to an AUX port. Typically the +5-V power supply current to GPS modems should be limited to less than 200 mA.

CHAPTER 4

Fast Ethernet Switch Mobile Interface Card

The Fast Ethernet Switch Mobile Interface Card is a mobile interface card (MIC) in a standard PC/104-*Plus* form factor. FESMICs are components of the Cisco 3200 Series Mobile Access Router. The 4-port FESMIC provides four sets of switched Fast Ethernet signals. The 2-port FESMIC provides two sets of switched Fast Ethernet signals.

The key features of the FESMIC include the following:

- Autosensing of switched Fast Ethernet interfaces.
- Auto-MDIX (medium-dependent interface crossover). Auto-MDIX automatically detects and corrects crossed Ethernet cabling.
- Support for 802.1D standard bridging, 802.1Q trunking, and 802.1P class of service (CoS).
- Layer 3 routing support between VLANs.

Only one FESMIC is supported in a Cisco 3200 Series router. Additional cards and components provide power and link interfaces to the FESMIC. The exact configuration of your router will vary, depending on how your vendor configured it.

Note This section provides basic information about the FESMIC hardware for the purpose of performing simple troubleshooting, such as reconnecting a loose cable. To solve more difficult problems, contact your vendor.

The FESMIC draws power from the PCI and the ISA connectors. Table 4-1 shows the estimated power consumption. Note that these are theoretical maximum wattages.

Table 4-1 FESMIC Estimated Power Consumption

Voltage	Current Draw	Power	Source
+5.0 V	0.2 A	1.0 W	ISA and PCI connectors
+3.3 V	2.3 A	7.7 W	PCI connectors

Autonegotiation and Auto-MDI/MDIX

All of the Fast Ethernet interfaces support Ethernet autonegotiation for the line transmission speed. Both sides of the connection are automatically set to either 10BASE-TX or 100BASE-TX. Autonegotiation is widely used on most Ethernet interfaces, and it is the default mode.

When a Fast Ethernet interface is enabled, one end of the link must perform media-dependent interface (MDI) crossover (MDIX), so that the transmitter on one end of the data link is connected to the receiver on the other end of the data link (a crossover cable is typically used). The Auto-MDIX feature eliminates the need for crossover cabling by performing an internal crossover when a straight cable is detected during the autonegotiation phase.

If autonegotiation is disabled, Auto-MDI/MDIX cannot work because there is no signal transmission at initialization to sample the cabling with. Therefore, as in all systems not supporting the HP Auto-MDIX feature, cabling must be correct for the devices being connected. The Auto-MDIX feature is disabled if you explicitly set the line speed rather than leaving the default mode of autonegotiation. Although it is possible to disable HP Auto-MDIX with autonegotiation enabled, the current software does not implement an explicit command-line interface (CLI) command to allow you to disable Auto-MDIX during autonegotiation.

Autonegotiation Enable

To enable autonegotiation, use the following configuration:

```
Router#(config) FastEthernet m/n
Router#(config-if) speed auto
```

where *m* is the slot and *n* is the port number.

Autonegotiation Disable

To disable autonegotiation and Auto-MDIX by forcing the line speed through a manual setting, enter the following configuration commands:

```
Router#(config) FastEthernet m/n
Router#(config-if) speed 10
```

or

```
Router#(config) FastEthernet m/n
Router#(config-if) speed 100
```

MAC Address Allocation

The 4-port FESMIC stores 4 unique MAC addresses for the 10/100 Ethernet interfaces. The 2-port FESMIC stores 2 unique MAC addresses for the 10/100 Ethernet interfaces. In addition, 37 MAC addresses are burned into Cisco 3270 Rugged Router card–equipped routers, and 33 MAC addresses are burned into the Mobile Access Router Card (MARC) to support the FESMIC per-VLAN spanning tree (PVST) and inter-VLAN routing features.

To provide support for up to 32 VLANs, and the 32 Spanning Tree Protocol (STP) sessions that might be running, 32 unique MAC addresses are required for the bridge packet data unit (BPDU) IDs. In addition, the FESMIC needs one MAC address for VLAN routing, bringing the total of number of MAC addresses on the wired router to 34. To support future development, the MAC addresses are burned into the Mobile Access Router Card (MARC), instead of the FESMIC.

FESMIC Component Systems

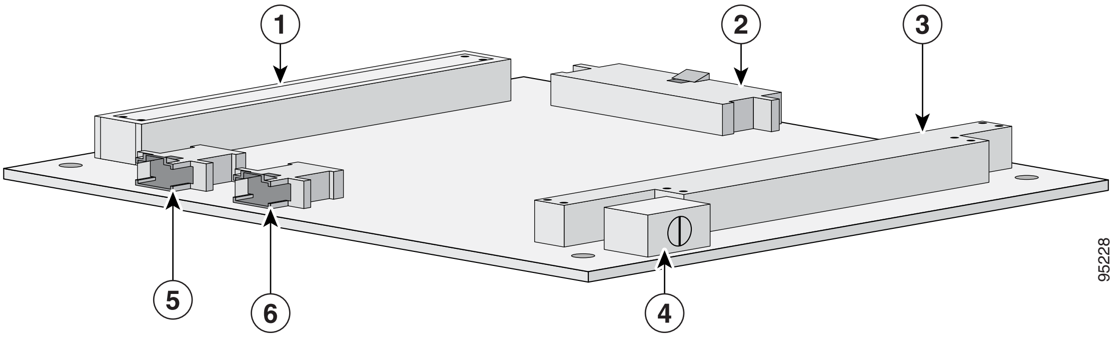
The ISA buses and PCI buses on the Cisco 3200 Series Mobile Access Router cards provide power to the components on the cards. Both buses comply with the PC/104-*Plus* standard. The ISA bus allows PC/104-*Plus* ISA signals to pass through the card bus, but the Cisco cards do not use any of the signals.

The PCI bus signals allow the Cisco cards to communicate. Non-Cisco cards cannot communicate with the Cisco 3200 Series Mobile Access Router cards over the PCI bus.

Caution If you add non-Cisco cards that generate signals on the PCI bus, the router might shut down. Do not add non-Cisco cards that generate signals on the PCI bus.

Figure 4-1 shows the 2-port FESMIC header and bus locations.

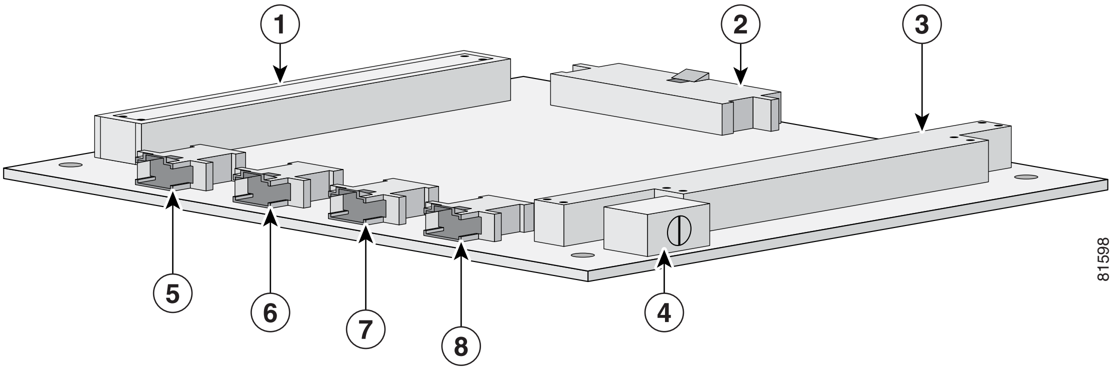
Figure 4-1 2-port FESMIC Header and Bus Locations



1	PCI bus	**2**	20-pin LED header
3	ISA bus	**4**	Rotary switch
5	FE0 Fast Ethernet header	**6**	FE1 Fast Ethernet header

Figure 4-2 shows the 4-port FESMIC header and bus locations.

Figure 4-2 4-port FESMIC Header and Bus Locations



1	PCI bus	**2**	20-pin LED header
3	ISA bus	**4**	Rotary switch
5-8	E0–E3 Fast Ethernet headers		

Note The PC/104-*Plus* standard requires that the PCI bus and the ISA bus use keying features in the standard stacking headers to guarantee proper module installation. On the PCI bus, pin D30 is removed and the D30 opening is plugged. On the ISA bus, pin C19 and pin B10 are removed, and their openings are plugged.

Signals for the FESMIC

The signals are delivered through 10-pin headers, with one set of Fast Ethernet signals per header. LED signals and 5 V of power are provided through the 20-pin LED header. Cisco 3200 Series router cards do not support any ISA bus signals.

The PCI bus connector supports communication between the FESMIC, the Serial Mobile Interface Card (SMIC), and the Cisco 3270 Rugged Router card or Mobile Access Router Card (MARC). The Wireless Mobile Interface Card (WMIC) communicates with the router through an internal Fast Ethernet port and is configured through an independent console port; the WMIC draws power only from the bus.

The Fast Ethernet port signals are in compliance with IEEE 802.3. They are provided through the Ethernet headers, which support the following:

- Autonegotiation for 10/100BASE-TX connection
- Full-duplex and half-duplex modes
- Low-power sleep mode
- 10BASE-T and 100BASE-TX using a single Ethernet connection
- Robust baseline-wander correction performance
- Standard carrier signal multiple access collision detect (CSMA/CD) or full-duplex operation
- Integrated LED drivers

The Fast-Ethernet ports on the 4-port FESMIC and the 2-port FESMIC are Fast Ethernet *switch* ports. The switch ports support all Layer 2 features. The Fast-Ethernet 0/0 port on the Cisco 3270 Rugged Router card and MARC is a Fast Ethernet *router* port. The routing features supported on the MARC cannot be configured on the FESMIC ports.

FESMIC Rotary Switch Positions

A Cisco router identifies a Fast Ethernet interface address by its slot number and port number, in the form of *slot/port*. The slot/port addresses of the Fast Ethernet interfaces on the FESMIC depend on the position of the rotary switch.

For example, if the rotary switch on the 4-port FESMIC is in position 0, then the ports are identified as 1/0, 1/1, 1/2, and 1/3. If the rotary switch on the 2-port FESMIC is in position 0, the ports are identified as 1/0 and 1/1.

Table 4-2 shows the mapping of the switch positions to the Cisco IOS slot numbers.

Table 4-2 FESMIC Rotary Switch Positions

Switch Position	Cisco IOS Slot Number
0	1
1	2
2	3
3–7	Not supported

Caution The rotary switch positions must be unique and should not be assigned to more than one MIC.

- If a MIC rotary switch is set to 3 or higher, the message is:

  "MIC-3-SLOTNOTSUPPORTED: The MIC cannot operate when the rotary switch is in position 3. Change the switch position to one of the supported, unused positions 0-2."

- If two or more MICs have the rotary switches set to the same position, or if one or more MICs are in rotary switch positions 4 through 7, the router might crash after displaying the following error message:

  "Non-recoverable error occurred. Please check the rotary switch positions on the MIC cards for the possible misconfiguration of the switch position."

Table 4-3 shows the FESMIC Fast Ethernet signal assignments. The position of the rotary switch determines the port assignments. Although the rotary switch has eight positions, only one of three positions can be selected. The rotary switch position should be unique for each MIC.

Table 4-3 FESMIC Rotary Switch Positions and Signal Assignments

Rotary Switch Position	MIC Slot	Fast Ethernet Signal Assignments			
0	1	FE 1/0	FE 1/1	FE 1/2[1]	FE 1/3[1]
1	2	FE 2/0	FE 2/1	FE 2/2[1]	FE 2/3[1]
2	3	FE 3/0	FE 3/1	FE 3/2[1]	FE 3/3[1]

[1] For 4-port FESMIC only.

CHAPTER 5

Serial Mobile Interface Card

The Serial Mobile Interface Card is one component of the Cisco 3200 Series Mobile Access Router. It provides the router up to 4 high–speed sets of serial signals in both data terminal equipment (DTE) and data circuit equipment (DCE) modes. Additional components provide power and link interfaces to the SMIC. For example, the Cisco 3270 Rugged Router card provides the host processor, memory, and headers for the Fast Ethernet, console, and auxiliary signals for the router. The exact configuration of your router will vary, depending on how it was configured by your vendor.

Note This section provides basic information about the SMIC hardware for the purpose of performing simple troubleshooting, such as reconnecting a loose cable. To solve more difficult problems, please contact your vendor.

Each SMIC provides the following:

- Support for two to four sets of serial signals with protocol support for High-Level Data Link Control (HDLC), asynchronous, synchronous and octet-oriented PPP modes. The signals can be configured to any serial standard (EIA/TIA-232, EIA/TIA-449, EIA/TIA-530, EIA/TIA-530A, EIA/TIA-X.21, or CCITT V.35).
- DCE and DTE mode support on each set of serial signals.
- Speeds of 2 Mbps for synchronous data transfer and 115 kbps for asynchronous data transfer on each serial interface. All serial standards reach 2 Mbps (for synchronous) except for the EIA/TIA-232 standard, which supports up to 192K.

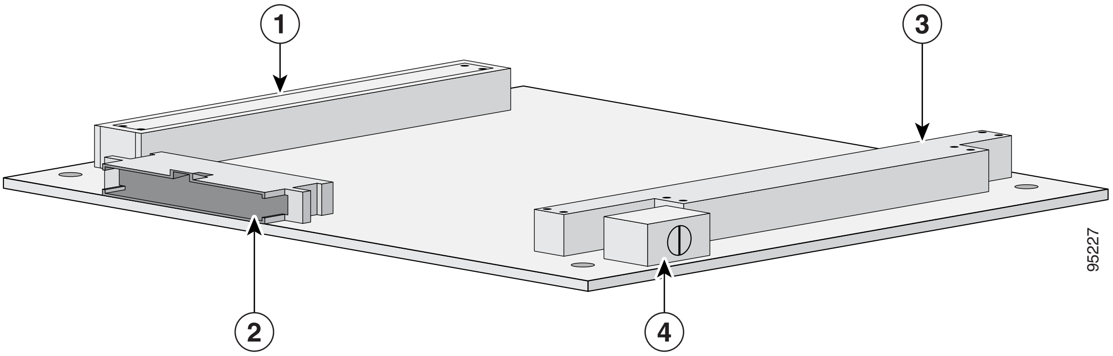
Note The Peripheral Component Interconnect (PCI) bus and the Industry Standard Architecture (ISA) bus use keying features in the standard stacking headers to guarantee proper module installation. On the PCI bus, pin D30 is removed and its opening is plugged. On the ISA Bus, pin C19 and pin B10 are removed, and their openings are plugged.

The PCI bus connector supports communication between the SMIC, the Fast Ethernet Switch Mobile Interface Card (FESMIC), and the Cisco 3270 Rugged Router card or Mobile Access Router Card (MARC). The Wireless Mobile Interface Card (WMIC) communicates with the router through an internal Fast Ethernet port and is configured through an independent console port; the WMIC only draws power only from the bus.

SMIC Component Systems

Figure 5-1 shows the 2-port SMIC header and bus locations.

Figure 5-1 2-port SMIC Header and Bus Locations

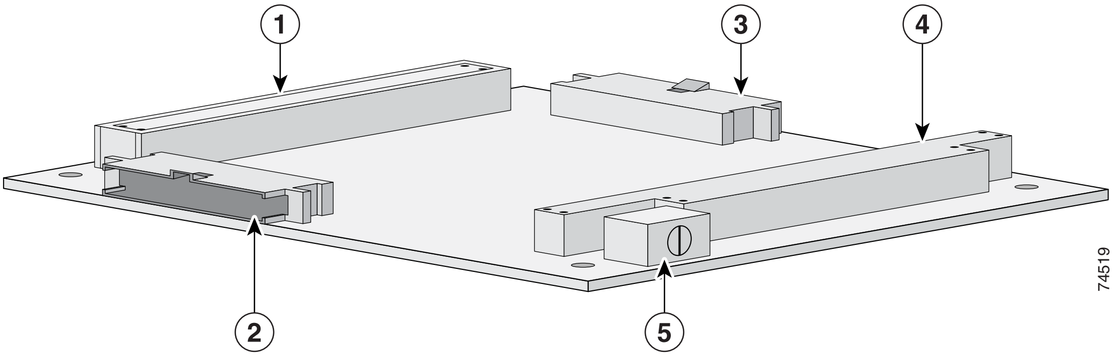


1	PCI bus	2	60-pin multifunction header for Serial 0 and Serial 1 signals
3	ISA bus	4	Rotary switch

Figure 5-2 shows the 4-port SMIC header and bus locations.

Caution If you add non-Cisco cards that generate signals on the PCI bus, the router might shut down. Do not add non-Cisco cards that generate signals on the PCI bus.

Figure 5-2 4-port SMIC Header and Bus Locations



1	PCI bus	2	60-pin multifunction header for Serial 2 and Serial 3 signals
3	60-pin multifunction header for Serial 0 and Serial 1 signals	4	ISA bus
5	Rotary switch		

Signals for the SMIC

The Cisco Single-sideband (SSB) Serial standard supports the following:

- EIA/TIA-232, EIA/TIA-449, EIA-530, EIA-530A, X.21, and V.35 standards in both DTE and DCE modes.
- Signals (SSB and LED) are provided through the 60-pin multifunction header(s).

The position of the rotary switch determines the port assignments. Although the rotary switch has eight positions, only positions 0, 1, and 2 are supported on the 4-port SMIC, and only positions 0 and 1 are supported on the 2-port SMIC.

Table 5-1 provides 4-port SMIC port assignments.

Table 5-1 4-port SMIC Rotary Switch Settings and Port Assignments

Position	MIC Slot	Port Assignments			
0	1	Serial 1/0	Serial 1/1	Serial 1/2	Serial 1/3
1	2	Serial 2/0	Serial 2/1	Serial 2/2	Serial 2/3
2	3	Serial 3/0	Serial 3/1	Serial 3/2	Serial 3/3

Table 5-2 provides the 2-port SMIC port assignments.

Table 5-2 2-port SMIC Rotary Switch Settings and Port Assignments

Position	MIC Slot	Port Assignments	
0	1	Serial 1/0	Serial 1/1
1	2	Serial 2/0	Serial 2/1

4-Port SMIC Rotary Switch Positions

Table 5-3 shows the 4-port SMIC serial signal assignments. The position of the rotary switch determines the port assignments. Although the rotary switch has 8 positions, only 1 of 4 positions can be selected. The rotary switch position should be unique for each mobile interface card (MIC) card.

Table 5-3 4-port SMIC Rotary Switch Positions and Serial Set Signal Assignments

Rotary Switch Position	MIC Slot	Signal Assignments			
0	1	Serial 1/0	Serial 1/1	Serial 1/2	Serial 1/3
1	2	Serial 2/0	Serial 2/1	Serial 2/2	Serial 2/3
2	3	Serial 3/0	Serial 3/1	Serial 3/2	Serial 3/3
3	4	Serial 4/0	Serial 4/1	Serial 4/2	Serial 4/3

2-port SMIC Rotary Switch Positions

Table 5-4 shows the 2-port SMIC serial signal assignments. The position of the rotary switch determines the port assignments. Although the rotary switch has 8 positions, only 1 of 2 positions can be selected. The rotary switch position should be unique for each mobile interface card (MIC) card.

Table 5-4 2-port SMIC Rotary Switch Positions and Serial Set Signal Assignments

Rotary Switch Position	MIC Slot	Signal Assignments			
0	1	Serial 1/0	Serial 1/1	Serial 1/2	Serial 1/3
1	2	Serial 2/0	Serial 2/1	Serial 2/2	Serial 2/3

SMIC LED Signals

Table 5-5 shows the LED signals that are supported on the SMIC, along with the corresponding functions. Serial 2 and Serial 3 apply to the 4-port SMIC only.

Table 5-5 SMIC LED Functions

LED	Function
SERIAL0 ACTIVITY	Blinks once when a packet is either transmitted from or received on Serial 0. Originates from Header 5.
SERIAL0 LINK	Indicates the status of Serial 0. Originates from Header 5. The LED is on when a serial port is in DTE mode, and when the data set ready (DSR), data carrier detect (DCD), and clear to send (CTS) signals are detected. The LED is on when a serial port is in DCE mode, and when the data terminal ready (DTR) and request to send (RTS) signals are detected.
SERIAL1 ACTIVITY	Blinks once when a packet is either transmitted from or received on Serial 1. Originates from Header 5.
SERIAL1 LINK	Indicates the status of Serial 1. Originates from Header 5. The LED is on when the serial port is in DTE mode, and when the DSR, DCD, and CTS signals are detected. The LED is on when the serial port is in DCE mode, and when the DTR and RTS signals have been detected.
SERIAL2 ACTIVITY	Blinks once when a packet is either transmitted from or received on Serial 2. Originates from Header 2.
SERIAL2 LINK	Indicates the status of Serial 2. Originates from Header 2. The LED is on when the serial port is in DTE mode, and when the DSR, DCD, and CTS signals are detected. The LED is on when the serial port is in DCE mode, and when the DTR and RTS signals have been detected.
SERIAL3 ACTIVITY	Blinks once when a packet is either transmitted FROM or received on Serial 3. Originates from Header 2.
SERIAL3 LINK	Indicates the status of Serial 3. originates from Header 2. The LED is on when the serial port is in DTE mode, and when the DSR, DCD, and CTS signals are detected. The LED is on when the serial port is in DCE mode, and when the DTR and RTS signals have been detected.

SMIC Power Consumption

The SMIC draws power from the PCI and the ISA connectors.

Table 5-6 shows the estimated power consumption. Note that these are theoretical maximum wattages.

Table 5-6 SMIC Estimated Power Consumption

Voltage	Current Draw	Power	Source
+5.0 V	1.0 A	5.0 W	ISA and PCI connectors
+3.3 V	0.5 A	1.7 W	PCI connectors

CHAPTER 6

Wireless Mobile Interface Cards

The Cisco Wireless Mobile Interface Card (WMIC) is a Cisco 3200 Series router interface card in a standard PC/104-*Plus* form factor.

It is one component of the Cisco 3200 Series routers and provides a wireless interface with the following:

- 2.4 GHz (802.11b/g) – Cisco 3201
- 4.9 GHz (public safety) – Cisco 3202
- 5.0 GHz (802.11h) – Cisco 3205

Caution The 4.9 GHz (public safety) radio requires an operators license and can be operated only by US Public Safety operators who meet the requirements specified under FCC Part 90.20.

This chapter provides basic information about the WMIC hardware for performing simple troubleshooting, such as reconnecting a loose cable. To solve more difficult problems, contact your vendor.

WMIC Component Systems

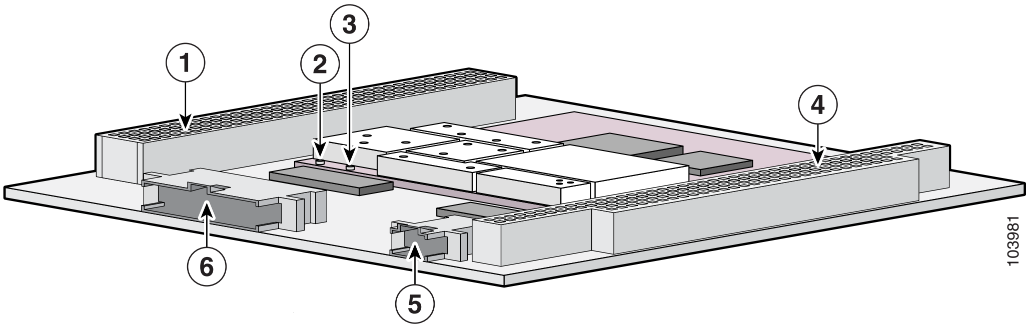
The ISA buses and PCI buses on the Cisco 3200 Series router cards provide power to the components on the cards. The WMIC does not receive or transmit communications signals on either bus, but it will pass signals through the bus to a card above or below the WMIC. Both buses comply with the PC/104-*Plus* standard.

The PCI bus signals allow the Cisco cards to communicate. Non-Cisco cards cannot communicate with the Cisco 3200 Series Router cards over the PCI bus.

Caution If you add non-Cisco cards that generates signals on the PCI bus, the router might shut down. Do not add non-Cisco cards that generate signals on the PCI bus.

Figure 6-1 shows the WMIC header and bus locations.

Figure 6-1 *WMIC Header and Bus Locations*



1	PCI bus	**2**	Left antenna connector (J2)
3	Right antenna connector (J1)	**4**	ISA bus
5	10-pin Fast Ethernet header	**6**	24-pin multifunction header

Note The PC/104-Plus standard requires that the PCI bus and the ISA bus use keying features in the standard stacking headers to guarantee proper module installation. On the PCI bus, pin D30 is removed and its opening is plugged. On the ISA bus, pin C19 and pin B10 are removed, and their openings are plugged.

Antenna Connector

On the radio card, two ultra-miniature coaxial connectors (U.FL connector) connect the coax cables between the WMIC and the external antenna connectors. Two connectors support antenna diversity.

The cable should be as short as possible to minimize the loss in strength of the RF signal. The cable carries the RF signal from the antenna to the low noise amplifier (LNA) on the receiver and carries the RF signal from the power amplifier (PA) to the antenna that radiates the RF signal.

There are many antenna connector families. The Cisco RP-TNC antenna connector can be used to support standard antennas.

WMIC Console and Fast Ethernet Ports

Cisco 3200 Series router cards do not support any ISA bus signals. The PCI bus connector supports communication between the Cisco 3200 Series router card and the PCI Serial Mobile Interface Card (SMIC) and between the SMIC and the Fast Ethernet Switch Mobile Interface Card (FESMIC).

In a Cisco Rugged Enclosure, the WMIC communicates with the router through the WMIC Fast Ethernet interface. The WMIC Fast Ethernet ports are connected internally to Fast Ethernet ports that provide a communications link with the router.

The WMIC interfaces are configured through a WMIC console port.

In contrast, the Serial Mobile Interface Card (SMIC) and FESMIC communicate with the router through the PC/104-*Plus* bus. The interfaces are configured through the router console port, and all of the router and FESMIC Fast Ethernet ports are identified by using the slot/port format.

The WMIC runs an independent Cisco IOS image and when it is configured, the link between the WMIC and the router forms an internal LAN. In standard configurations, a WMIC Fast Ethernet port is never brought out to the end cap.

The WMIC console port is brought out to the corresponding RJ-45 port on the I/O end cap, replacing a Fast Ethernet port. If the router includes one WMIC, the RS-232 WMIC console port replaces a Fast Ethernet port on the end cap. If the router includes two WMICs, two WMIC EIA/TIA-232 console ports replace two Fast Ethernet ports on the end cap.

Note At present, even if the router contains zero WMICs, in standard configurations a maximum of three Fast Ethernet ports are brought out to the end cap. Unused EIA/TIA-232 ports are sealed.

Fast Ethernet Signals on the WMIC

The Fast Ethernet signals are delivered through a 10-pin header. LED signals and EIA/TIA-232 console signals are provided through the 24-pin multifunction header.

There is one set of fixed Fast Ethernet signals on the WMIC. The Fast Ethernet port signals comply with IEEE 802.3. The signals are provided through the Ethernet headers, which support the following:

- Autonegotiation for 10/100BASE-TX connection
- Full-duplex and half-duplex modes
- Low-power sleep mode
- 10BASE-T and 100BASE-TX using a single Ethernet connection
- Robust baseline wander correction performance
- Standard carrier signal multiple access collision detect (CSMA/CD) or full-duplex operation
- Integrated LED drivers

Note If Auto-MDIX is disabled, when connecting to Ethernet switches or repeaters, use a straight-through cable. When connecting to compatible workstations, servers, and routers, use a crossover cable. If Auto-MDIX is enabled, you can use either a straight-through cable or a crossover cable to make the connection, as the router automatically changes the signals on the pins to compensate.

LED Behavior

During normal operations, the indicator signals (LEDs) on the wireless device have the following meanings:

- The status indicator signals operational status. Steady green indicates that the wireless device is associated with at least one wireless client. Blinking green indicates that the wireless device is operating normally but is not associated with any wireless devices.
- The radio indicator blinks green to indicate radio traffic activity. The light is normally off, but it blinks whenever a packet is received or transmitted over the radio.
- The Ethernet indicator signals traffic on the wired LAN. This indicator is normally green when an Ethernet cable is connected. The indicator blinks green when a packet is received or transmitted over the Ethernet infrastructure. The indicator is off when the Ethernet cable is not connected.

Table 6-1 lists the details of LED indicator signals.

Table 6-1 Indicator Signals

Message Type	Ethernet Indicator	Status Indicator	Radio Indicator	Meaning
Boot loader status	Green	—	Green	DRAM memory test.
	—	Amber	Red	Board initialization test.
	—	Blinking green	Blinking green	Flash memory test.
	Amber	Green	—	Ethernet initialization test.
	Green	Green	Green	Starting Cisco IOS software.
Association status	—	Green	—	At least one wireless client device is associated with the unit.
	—	Blinking green	—	No client devices are associated; check the wireless device service set identifier (SSID) and Wired Equivalent Privacy (WEP) settings.
Operating status	—	Green	Blinking green	Transmitting/receiving radio packets.
	Green	—	—	Ethernet link is operational.
	Blinking green	—	—	Transmitting/receiving Ethernet packets.
Boot Loader Errors	Red	—	Red	DRAM memory test failure.
	—	Red	Red	File system failure.
	Red	Red	—	Ethernet failure during image recovery.
	Amber	Green	Amber	Boot environment error.
	Red	Green	Red	No Cisco IOS image file.
	Amber	Amber	Amber	Boot failure.

Table 6-1 Indicator Signals (continued)

Message Type	Ethernet Indicator	Status Indicator	Radio Indicator	Meaning
Operation Errors	–	Green	Blinking amber	Maximum retries or buffer full occurred on the radio.
	Blinking amber	–	–	Transmit/receive Ethernet errors.
	–	Blinking amber	–	General warning.
Configuration Reset	–	Amber	–	Resetting the configuration options to factory defaults.
Failures	Red	Red	Red	Firmware failure; try disconnecting and reconnecting unit power.
	Blinking red	–	–	Hardware failure. The wireless device must be replaced.
Firmware Upgrade	–	Red	–	Loading new firmware image.

Key Features

Table 6-2 lists the key features of the Cisco wireless devices.

Table 6-2 Key Features

Feature	Description
Wireless Medium	Direct Sequence Spread Spectrum (DSSS). Orthogonal Frequency Division Multiplexing (OFDM).
Radio Media Access Protocol	Carrier sense multiple access with collision avoidance (CSMA/CA).
SNMP Compliance	MIB I and MIB II.
Encryption Key Length	128-bit.
Quality of Service (QoS) Support	Prioritization of traffic for different requirements, such as voice and video.

Table 6-2 Key Features (continued)

Feature	Description
Security	Cisco Wireless Security Suite: **Authentication:** • 802.1X support including Extensible Authentication Protocol (EAP)-Transport Layer Security (TLS), Lightweight EAP (LEAP), Protected EAP (PEAP), and EAP-Subscriber Identity Module (SIM) to yield mutual authentication and dynamic, per-user, per-session WEP keys. • MAC address and by standard 802.11 authentication mechanisms. **Encryption:** • Static and dynamic IEEE 802.11 WEP keys of 40 bits and 128 bits. • 802.11i/WPAv2 Advanced Encryption Standard-Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (AES-CCMP); 128-bit key length. • Temporal Key Integrity Protocol (TKIP) WEP enhancements: key hashing (per-packet keying), message integrity check (MIC), and broadcast key rotation by using WPA TKIP. **All WMICs in Root Mode:** PEAP, EAP-TTLS, LEAP, EAP-TLS, EAP-FAST, and EAP-SIM. **Cisco 3201 WMICs in Client Mode:** LEAP, EAP-TLS, and EAP-FAST. **Cisco 3202 and Cisco 3205 WMICs in Client Mode:** LEAP.
Status Indicators	LEDs provide information about association status, operation, error/warning, firmware upgrade, and configuration, network/modem, and radio status.
Memory	8 MB Flash. 32 MB DRAM.
Automatic Configuration Support	BOOTP and DHCP.
Remote Configuration Support	Telnet, HTTP, FTP, TFTP, and SNMP.
Uplink	Autosensing 10/100BaseT Ethernet.
Local Configuration	Console port.

MAC Address Allocation

The WMIC stores one unique MAC address for the BVI interface.

WMIC Power Requirement

In a typical Cisco 3200 Series router configuration, the WMIC draws power from the PCI and the ISA connectors. Table 6-3 shows the estimated power consumption. Note that these are theoretical maximum wattages.

Table 6-3 WMIC Power Requirement

Voltage	Current Draw	Power	Source
+5.0 V	0.4 A	2.0 W	ISA and PCI connectors
+3.3 V	1.7 A	5.6 W	PCI connectors

Mean Time Between Failure

The calculated Mean Time Between Failure (MTBF) exceeds of 1,190,136 hours.

Differences Between WMICs

Table 6-4 highlights the differences between WMICs.

Table 6-4 Differences Between WMICs

Feature	2.4 GHz (802.11b/g)	4.9 GHz (public safety)	5.0 GHz (802.11h)	Comment
Cookie and banner	C3201.	C3202.	C3205.	—
Frequency	2.4 GHz.	4.9 GHz.	5.0 GHz.	—
Power	Maximum Orthogonal Frequency-Division Multiplexing (OFDM) power level is 15 dbm (30 mw), but the power level might vary by country.	Maximum OFDM power level is 17 dbm (50 mw).	The power levels can be defined as 4 dBm, 7 dBm, 10 dBm, 13 dBm, or 16 dBm.	—
Transmission Power Control (TPC)	Not supported.	Not supported.	Supported for ETSI.	TPC limits the transmitted power to the minimum power level needed to reach the farthest user.
Dynamic Frequency Selection (DFS)	—	—	Supported for ETSI.	DFS selects the radio channel most likely to minimize interference with military radar.

Table 6-4 Differences Between WMICs (continued)

Feature	2.4 GHz (802.11b/g)	4.9 GHz (public safety)	5.0 GHz (802.11h)	Comment
Channelization	Statically declared as defined by IEEE 802.11b/g.	Channel width configured by using the command-line interface (CLI).	Statically declared as defined by IEEE 802.11a.	—
Concatenation	Supported.	Not supported.	Not supported.	—
Autonomous Modes Supported	Work Group Bridge (WGB), Universal WGB, Non Root Bridge (NRB), Root Bridge (RB), Repeater, and Access Point (AP).	Work Group Bridge (WGB), Non Root Bridge (NRB), Root Bridge (RB), and Access Point (AP).	Work Group Bridge (WGB), Non Root Bridge (NRB), Root Bridge (RB), and Access Point (AP).	—
World Mode	Supported.	Not supported.	Not supported.	World mode on the client side updates a client with the channels of the specified domain. The Cisco 3200 Series router is limited to fixed channels, so world mode is not available on the client side.
Universal Workgroup Bridge Mode	Supported.	Not supported.	Not supported.	Enables operation with non-Cisco access points.
Multiple Client Profiles	Supported.	Supported.	Supported.	
Multiple Basic SSIDs	Supported.	Supported.	Supported.	This mode is for root access-point only.
Wireless encryption/cipher suites	WEP-40, WEP-128, TKIP, CKIP, CMIC and CKIP-CMIC.	WEP-40, WEP-128, TKIP, and AES-CCM.	WEP-40, WEP-128, TKIP, and AES-CCM.	—
Max Number of Stations with WEP	255.	116.	116.	—
Max Number of Stations with TKIP	256.	26.	26.	—
Max Number of Stations with AES-CCM	256.	116.	116.	—

Table 6-4 Differences Between WMICs (continued)

Feature	2.4 GHz (802.11b/g)	4.9 GHz (public safety)	5.0 GHz (802.11h)	Comment
Fast Roaming Scanning Enhancements	All scanning enhancements for faster roaming are available.	All scanning enhancements for faster roaming are available except "Use First Better Access Point."	Fast roaming is not supported due to DFS nature. But normal roaming with scanning enhancement are available.	
Simple Network Management Protocol (SNMP) MIB IDs	Supported.	Supported for new values.	Supported.	The platform-dependent SNMP code was modified to return new values (entPhysicalVendorType, System OID, and Chassis ID).

2.4-GHz (802.11b/g) WMIC Features

The key features of the 2.4-GHz (802.11b/g) WMIC are listed in Table 6-5.

Table 6-5 Key 2.4-GHz (802.11b/g) WMIC Features

Feature	Description
Data Rates Supported	1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, and 54 Mbps
Network Standard	IEEE 802.11b and IEEE 802.11g
Frequency Band	2.400 GHz to 2.497 GHz
Modulation	BPSK[1] 1 Mbps and 6 Mbps QPSK[2] 2 Mbps and 12 Mbps CCK[3] 5.5 Mbps BPSK[1] 9.6 Mbps CCK2[3] 11 Mbps QPSK[2] 18 Mbps 16 QAM[4] 24 Mbps and 36 Mbps 64 QAM[4] 48 Mbps and 54 Mbps
Operating Channels	North America: 11; ETSI: 13; Japan: 14
Receive Sensitivity	1 Mbps: -94 dBm 2 Mbps: -91 dBm 5.5 Mbps: -89 dBm 11 Mbps: -85 dBm
Transmit Power Settings	100 mW (20 dBm) 50 mW (17 dBm) 30 mW (15 dBm) 20 mW (13 dBm) 5 mW (7 dBm) 1 mW (0 dBm) Maximum power settings vary to comply with the regulatory domain.

Table 6-5 Key 2.4-GHz (802.11b/g) WMIC Features

Feature	Description
Range (typical at 100-mW transmit power setting with 6-dBi diversity dipole antenna)	Outdoor: 0.5 mile (804 m) at 45 Mbps 1 mile (1609 m) at 11 Mbps 3 miles (4,827 m) at 1 Mbps
Compliance	2.4 GHz (802.11b/g) operates license free under FCC Part 15 and qualifies as a Class B device; complies with DOC regulations; complies with ETS 300.328, FTZ 2100, and MPT 1349 standards; rugged version complies with UL 2043

1. Binary Phase-shift keying (PSK)
2. Quadrature PSK
3. Complementary Code Keying
4. Quadrature Amplitude Modulation

Table 6-6 shows the channel identifiers, channel center frequencies, and regulatory domains of each IEEE 802.11b/g 22-MHz-wide channel.

Table 6-6 Channels for IEEE 802.11b/g

Channel Identifier	Center Frequency (MHz)	Regulatory Domains					
		Americas (–A)		EMEA (–E)		Japan (–J)	
		CCK	OFDM	CCK	OFDM	CCK	OFDM
1	2412	X	X	X	X	X	X
2	2417	X	X	X	X	X	X
3	2422	X	X	X	X	X	X
4	2427	X	X	X	X	X	X
5	2432	X	X	X	X	X	X
6	2437	X	X	X	X	X	X
7	2442	X	X	X	X	X	X
8	2447	X	X	X	X	X	X
9	2452	X	X	X	X	X	X
10	2457	X	X	X	X	X	X
11	2462	X	X	X	X	X	X
12	2467	–	–	X	X	X	X
13	2472	–	–	X	X	X	X
14	2484	–	–	–	–	X	–

Universal Workgroup Bridge Limitations

The following limitations and restrictions apply to universal workgroup bridges:

- A universal workgroup bridge cannot associate with the Cisco WLAN AP when the bridge is configured with CKIP or CMIC encryption.
- If the universal workgroup bridge is associated with a Cisco AP or third-party AP and if the user issues the **show dot11 association all** command, the IP address and name information is not available.
- Users should configure the static IP address on the Bridge-Group Virtual Interface (BVI) when it is in the universal workgroup bridge mode, so that the WMIC is manageable from the MAR through the Mobile IP tunnel from the infrastructure side.
- If the dynamic Collocated Care-of Address (CCoA) is used on the Cisco 3200 Series Wireless and Mobile Router, you should configure the static IP address using the **ip secondary address** command.
- The universal workgroup bridge is not compatible with the Tropos version 3.1.1.2 AP.
- A universal workgroup bridge cannot associate with the Cisco 1500 router when it is configured with the Allow WPA2 TKIP Clients option.

4.9-GHz (Public Safety) WMIC Features

Table 6-7 lists the key features of the 4.9-GHz (public safety) WMIC.

Table 6-7 Key Features of the 4.9-GHz (Public Safety) WMIC

Feature	Description
Data Rates Supported	5-MHz channelization: 1.5, 2.25, 3, 4.5, 6, 9, 12, and 13.5 Mbps. 10-MHz channelization: 3, 4.5, 6, 9, 12, 18, 24, and 27 Mbps. 20-MHz channelization: 6, 9, 12, 18, 24, 36, 48, and 54 Mbps.
Network Standard	At present, there is no IEEE 4.9-GHz (public safety) standard; however, the public safety standard for the 4.9-GHz WMIC is similar to the IEEE 802.11a standard.
Frequency Band	4.940 GHz to 4.990 GHz.
Available Transmit Power Settings	50 mW (17 dBm). 40 mW (16 dBm). 30 mW (15 dBm). 20 mW (13 dBm). 10 mW (10 dBm). 5 mW (7 dBm).
Compliance	4.9 GHz (public safety): • Operation restricted to operators meeting requirements of CFR47 Part 90.20 of the technical rules for qualification as a Public Safety operator. • Requires an FCC license to operate under this part of the Part 90 Regulation.

4.9-GHz Channels

Table 6-8 lists the channel options for the 4.94-GHz to 4.99-GHz band for the United States regulatory domain as per the TIA TR-8 specification.

Table 6-8 FCC 4.9-GHz Operational Channels as per the TIA TR-8 Specification

Operating Channel Numbers	Channel Center 5-MHz Channel Spacing	Channel Center 10-MHz Channel Spacing	Channel Center 20-MHz Channel Spacing
1	—	—	—
3	—	—	—
5	4942.5	—	—
7	—	—	—
9	—	—	—
10	—	4945.0	—
15	4947.5	—	—
20	—	4950.0	4950.0
25	4952.5	—	—
30	—	4955.0	4955.0
35	4957.5	—	—
40	—	4960.0	4960.0
45	4962.5	—	—
50	—	4965.0	4965.0
55	4967.5	—	—
60	—	4970.0	4970.0
65	4972.5	—	—
70	—	4975.0	4975.0
75	4977.5	—	—
80	—	4980.0	4980.0
85	4982.5	—	—
90	—	4985.0	—
91	—	—	—
93	—	—	—
95	4987.5	—	—
97	—	—	—
99	—	—	—

Note One-MHz channel spacing for Channel Center Frequencies is documented in the TIA TR-8 specification, but it is not supported by the 4.9-GHz (public safety) WMIC.

Throughput

The throughput is a minimum of:

- 4 Mbps half-duplex at one mile line-of-sight range for a 5 MHz-wide channel
- 8 Mbps half-duplex at one mile line-of-sight range for a 10 MHz-wide channel.
- 16 Mbps half-duplex at one mile line-of-sight range for a 20 MHz-wide channel.

Modulation

Table 6-9 lists the modulation supported modulations and data rates.

Table 6-9 Modulations and Data Rates

Modulation	5 Mbps	10 Mbps	20 Mbps
BPSK	1.5 Mbps and 2.25 Mbps	3 Mbps and 4.5 Mbps	6 Mbps and 9 Mbps
QPSK	3 Mbps and 4.5 Mbps	6 Mbps and 9 Mbps	12 Mbps and 18 Mbps
16 QAM	6 Mbps and 9 Mbps	12 Mbps and 18 Mbps	24 Mbps and 27 Mbps
64 QAM	12 Mbps and 13.5 Mbps	24 Mbps and 27 Mbps	48 Mbps and 54 Mbps

Receive Sensitivity

Table 6-10 shows the receive sensitivity for the 4.9-GHz WMIC.

Table 6-10 Receive Sensitivity for the 4.9-GHz WMIC

5 MHz		10 MHz		20 MHz	
1.5 Mbps	-89 dBm	3 Mbps	-87 dBm	6 Mbps	-85 dBm
2.25 Mbps	-89 dBm	4.5 Mbps	-87 dBm	9 Mbps	-85 dBm
3 Mbps	-89 dBm	6 Mbps	-87 dBm	12 Mbps	-85 dBm
4.5 Mbps	-85 dBm	9 Mbps	-87 dBm	18 Mbps	-82 dBm
6 Mbps	-82 dBm	12 Mbps	-85 dBm	24 Mbps	-79 dBm
9 Mbps	-79 dBm	18 Mbps	-79 dBm	36 Mbps	-76 dBm
12 Mbps	-74 dBm	24 Mbps	-74 dBm	48 Mbps	-71 dBm
13.5 Mbps	-72 dBm	27 Mbps	-72 dBm	54 Mbps	-69 dBm

5.0-GHz (802.11h) Radio Features

The 5-GHz radio supports only 20-MHz channelization. In addition, the 5-GHz radio supports Dynamic Frequency Selection (DFS) and Transmission Power Control (TPC) in the ETSI and FCC regulatory domains.

For more information about DFS and TPC, see *Radio Channels and Transmit Frequencies* at http://www.cisco.com/en/US/products/hw/routers/ps272/products_installation_and_configuration_guides_list.html.

Note 802.11h is supported only in the ETSI regulatory domain.

Note By default, the C3205 WMIC uses the right antenna to receive and transmit data.

5.0-GHz (802.11h) Channels

The 5.0-GHz (802.11h) radio in the Cisco 3200 Series router (currently available as the Cisco 3205 WMIC) supports the following channels and frequencies in the ETSI regulatory domain:

- 5.250 GHz to 5.350 GHz: 5260 MHz (52), 5280 MHz (56), 5300 MHz (60), 5320 MHz (64),
- 5.470 GHz to 5.725 GHz: 5500 MHz (100), 5520 MHz (104), 5540 MHz (108), 5560 MHz (112), 5580 MHz (116), 5600 MHz (120), 5620 MHz (124), 5640 MHz (128), 5660 MHz (132), 5680 MHz (136), 5700 MHz (140). (Channels 52 through 140 are ETSI outdoor channels.)

North America customers can use only the following frequencies in the 5.725-GHz to 5.850-GHz band:

- 5745 MHz (149)
- 5765 MHz (153)
- 5785 MHz (157)
- 5805 MHz (161)
- 5825 MHz (165)

Note By default, the C3205 WMIC performs automatic channel selection on the radio interface. For more information about configuring a channel on the radio interface of the Cisco 3205 WMIC by using the command-line interface (CLI), see the "Configuring the Radio Channel or Frequency for the C3205 WMIC" section in the *Radio Channels and Transmit Frequencies* document. To see Dynamic Frequency Selection (DFS) statistics, use the **show interface d0 dfs** command.

Throughput

The throughput is a minimum of 16 Mbps half-duplex at one mile line-of-sight range for a 20-MHz-wide channel. The range performance is dependent on output power, antenna gain, path loss, and other factors.

The following are range performance estimations:

- 6 Mbps at 10 kilometers (6 miles) at 30 dBm equivalent isotropically radiated power (EIRP)
- 1 Mbps at 30 kilometers (18 miles) at 30 dBm EIRP

Modulation

Table 6-11 lists the supported 5.0-GHz (802.11h) modulations and data rates.

Table 6-11 5.0-GHz (802.11h) Modulations and Data Rates

Modulation	20 Mbps
BPSK	6 Mbps and 9 Mbps
QPSK	12 Mbps and 18 Mbps
16 QAM	24 Mbps and 27 Mbps
64 QAM	48 Mbps and 54 Mbps

Receive Sensitivity

Table 6-12 shows the receive sensitivity for 5.0-GHz (802.11h) radios.

Table 6-12 Receive Sensitivity for 5.0-GHz (802.11h) Radios

Data Rates	5.25 GHz to 5.35 GHz	5.47 GHz to 5.725 GHz	5.725 GHz to 5.825 GHz[1]
6 Mbps	-85 dBm	-85 dBm	-85 dBm
9 Mbps	-85 dBm	-85 dBm	-85 dBm
12 Mbps	-85 dBm	-85 dBm	-85 dBm
18 Mbps	-82 dBm	-82 dBm	-82 dBm
24 Mbps	-79 dBm	-79 dBm	-79 dBm
36 Mbps	-76 dBm	-76 dBm	-76 dBm
48 Mbps	-71 dBm	-71 dBm	-71 dBm
54 Mbps	-69 dBm	-69 dBm	-69 dBm

[1] The 5.725-GHz to 5.825-GHz range is not supported on European models.

Transmit Sensitivity

Table 6-13 shows the transmit sensitivity for 5.0-GHz (802.11h) radios.

Table 6-13 Transmit Sensitivity for the C3205 WMIC

Data Rates	5.25 GHz to 5.35 GHz	5.47 GHz to 5.725 GHz	5.725 GHz to 5.825 GHz[1]
6 Mbps	16 dBm	16 dBm	16 dBm
9 Mbps	16 dBm	16 dBm	16 dBm
12 Mbps	16 dBm	16 dBm	16 dBm
18 Mbps	16 dBm	16 dBm	16 dBm
24 Mbps	16 dBm	16 dBm	16 dBm
36 Mbps	16 dBm	16 dBm	16 dBm
48 Mbps	14 dBm	14 dBm	14 dBm
54 Mbps	13 dBm	13 dBm	13 dBm

[1] The 5.725-GHz to 5.825-GHz range is not supported on European models.

Additional cards and components provide power and link interfaces to the WMIC. The exact configuration of your router will vary, depending on how the vendor configured it.

5-GHz WMIC (Cisco 3205)

The 5-GHz Cisco 3205 WMIC can be configured in any of the following modes:

- Root bridge
- Non-root bridge
- Workgroup bridge
- Access point

When configured in a workgroup bridge station role, the WMIC can associate to a Cisco 1522 Mesh Access Point, serving as a wireless backhaul for an in-vehicle mobile network.

The Cisco 3205 WMIC can also be used to set up point-to-point, or point-to-multipoint bridges. The new 5-GHz radio in this WMIC improves throughput at lower temperatures.

Supported Channels

North America customers can use only the following frequencies in the 5.725- to 5.850-GHz band:

5745 MHz (149)

5765 MHz (153)

5785 MHz (157)

5805 MHz (161)

5825 MHz (165)

To comply with FCC regulations, use of the following frequencies is prohibited in North America:

- 5.250 to 5.350 GHz: 5260 MHz (52), 5280 MHz (56), 5300 MHz (60), 5320 MHz (64)
- 5.470 to 5.725 GHz: 5500 MHz (100), 5520 MHz (104), 5540 MHz (108), 5560 MHz (112), 5580 MHz (116), 5600 MHz (120), 5620 MHz (124), 5640 MHz (128), 5660 MHz (132), 5680 MHz (136), 5700 MHz (140)
- For C3205 ETSI, the following channels are supported:
- 5500 MHz (channel 100)
- 5520 MHz (channel 104)
- 5540 MHz (channel 108)
- 5560 MHz (channel 112)
- 5580 MHz (channel 116)
- 5600 MHz (channel 120)
- 5620 MHz (channel 124)
- 5640 MHz (channel 128)
- 5660 MHz (channel 132)
- 5680 MHz (channel 136)

- •5700 MHz (channel 140)

Related Documentation

These documents provide detailed information regarding the configuration of the wireless card:

- *Cisco IOS Switching Services Configuration Guide.* Click this link to browse to this document: http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fswtch_c/index.htm
- *Cisco Internetwork Design Guide.* Click this link to browse to this document: http://www.cisco.com/univercd/cc/td/doc/cisintwk/idg4/index.htm
- *Cisco Internetworking Technology Handbook.* Click this link to browse to this document: http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/index.htm
- *Cisco Internetworking Troubleshooting Guide.* Click this link to browse to this document: http://www.cisco.com/univercd/cc/td/doc/cisintwk/itg_v1/index.htm

CHAPTER 7

Managing Firmware and Configurations

This chapter describes how to manipulate the flash file system, how to copy configuration files, and how to archive (upload and download) software images. It consists of these sections:

- Working with the Flash File System, page 7-1
- Working with Configuration Files, page 7-7
- Working with Software Images, page 7-18

Working with the Flash File System

The flash file system on your WMIC provides several commands to help you manage software image and configuration files.

The flash file system is a single flash device on which you can store files. This flash device is called *flash:*.

This section provides information on the following topics:

- Displaying Available File Systems, page 7-1
- Setting the Default File System, page 7-2
- Displaying Information About Files on a File System, page 7-3
- Changing Directories and Displaying the Working Directory, page 7-3
- Creating and Removing Directories, page 7-3
- Copying Files, page 7-4
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- Creating, Displaying, and Extracting tar Files, page 7-5
- Displaying the Contents of a File, page 7-7

Displaying Available File Systems

To display the available file systems on your WMIC, use the **show file systems** command as shown in this example:

```
bridge# show file systems
File Systems:

     Size(b)     Free(b)      Type  Flags  Prefixes
```

```
*   16128000    11118592      flash    rw   flash:
    16128000    11118592    unknown    rw   zflash:
       32768       26363      nvram    rw   nvram:
           -           -    network    rw   tftp:
           -           -     opaque    rw   null:
           -           -     opaque    rw   system:
           -           -     opaque    ro   xmodem:
           -           -     opaque    ro   ymodem:
           -           -    network    rw   rcp:
           -           -    network    rw   ftp:
```

Table 7-1 lists field descriptions for the **show file systems** command.

Table 7-1 show file systems Field Descriptions

Field	Value
Size(b)	Amount of memory in the file system in bytes.
Free(b)	Amount of free memory in the file system in bytes.
Type	Type of file system. **flash**—The file system is for a flash memory device. **network**—The file system is for a network device. **nvram**—The file system is for a nonvolatile RAM (NVRAM) device. **opaque**—The file system is a locally generated *pseudo* file system (for example, the *system*) or a download interface, such as brimux. **unknown**—The file system is an unknown type.
Flags	Permission for file system. **ro**—read-only. **rw**—read/write. **wo**—write-only.
Prefixes	Alias for file system. **flash:**—flash file system. **ftp:**—File Transfer Protocol (FTP) network server. Used to transfer files to or from the network device. **nvram:**—Non-volatile RAM memory (NVRAM). **null:**—Null destination for copies. You can copy a remote file to null to determine its size. **rcp:**—Remote Copy Protocol (RCP) network server. **system:**—Contains the system memory, including the running configuration. **tftp:**—Trivial File Transfer Protocol (TFTP) network server. **zflash:**—Read-only file decompression file system, which mirrors the contents of the flash file system.

Setting the Default File System

You can specify the file system or directory that the system uses as the default file system by using the **cd** *filesystem:* privileged EXEC command. You can set the default file system to omit the *filesystem:* argument from related commands. For example, for all privileged EXEC commands that have the optional *filesystem:* argument, the system uses the file system specified by the **cd** command.

By default, the default file system is *flash:*.

You can display the current default file system as specified by the **cd** command by using the **pwd** privileged EXEC command.

Displaying Information About Files on a File System

You can view a list of the contents of a file system before manipulating its contents. For example, before copying a new configuration file to flash memory, you might want to verify that the file system does not already contain a configuration file with the same name. Similarly, before copying a flash configuration file to another location, you might want to verify its filename for use in another command.

To display information about files on a file system, use one of the privileged EXEC commands in Table 7-2:

Table 7-2 Commands for Displaying Information About Files

Command	Description
dir [**/all**] [*filesystem***:**][*filename*]	Displays a list of files on a file system.
show file systems	Displays more information about each of the files on a file system.
show file information *file-url*	Displays information about a specific file.
show file descriptors	Displays a list of open file descriptors. File descriptors are the internal representations of open files. You can use this command to see if another user has a file open.

Changing Directories and Displaying the Working Directory

To change directories and display the working directory, follow these steps, beginning in privileged EXEC mode:

	Command	Purpose
Step 1	**dir** *filesystem***:**	Displays the directories on the specified file system. For *filesystem***:**, use **flash:** for the system board flash device.
Step 2	**cd new_configs**	Changes to the directory of interest. The command example shows how to change to the directory named *new_configs*.
Step 3	**pwd**	Displays the working directory.

Creating and Removing Directories

Beginning in privileged EXEC mode, follow these steps to create and remove a directory:

	Command	Purpose
Step 1	**dir** *filesystem***:**	Displays the directories on the specified file system. For *filesystem***:**, use **flash:** for the system board flash device.
Step 2	**mkdir old_configs**	Creates a new directory. The command example shows how to create the directory named *old_configs*. Directory names are case sensitive. Directory names are limited to 45 characters between the slashes (/); the name cannot contain control characters, spaces, deletes, slashes, quotes, semicolons, or colons.
Step 3	**dir** *filesystem***:**	Verifies your entry.

To delete a directory with all its files and subdirectories, use the **delete /force /recursive** *filesystem***:/***file-url* privileged EXEC command.

Use the **/recursive** keyword to delete the named directory and all subdirectories and the files contained in it. Use the **/force** keyword to suppress the prompting that confirms a deletion of each file in the directory. You are prompted only once at the beginning of this deletion process. Use the **/force** and **/recursive** keywords for deleting old software images that were installed by using the **archive download-sw** command but are no longer needed.

For *filesystem*, use **flash:** for the system board flash device. For *file-url*, enter the name of the directory to be deleted. All the files in the directory and the directory are removed.

Caution When files and directories are deleted, their contents cannot be recovered.

Copying Files

To copy a file from a source to a destination, use the **copy** [**/erase**] *source-url destination-url* privileged EXEC command. For the source and destination URLs, you can use **running-config** and **startup-config** keyword shortcuts. For example, the **copy running-config startup-config** command saves the currently running configuration file to the NVRAM section of flash memory to be used as the configuration during system initialization.

Network file system URLs include **ftp:**, **rcp:**, and **tftp:** and have the following syntax:

- File Transfer Protocol (FTP)—**ftp:**[[**//***username* [**:***password*]**@***location*]**/***directory*]**/***filename*
- Remote Copy Protocol (RCP)—**rcp:**[[**//***username***@***location*]**/***directory*]**/***filename*
- Trivial File Transfer Protocol (TFTP)—**tftp:**[[**//***location*]**/***directory*]**/***filename*

Local writable file systems include flash:.

Some invalid combinations of source and destination exist. Specifically, you cannot copy these combinations:

- From a running configuration to a running configuration
- From a startup configuration to a startup configuration
- From a device to the same device (for example, the **copy flash: flash:** command is invalid)

For specific examples of using the **copy** command with configuration files, see the "Working with Configuration Files" section on page 7-7.

To copy software images either by downloading a new version or uploading the existing one, use the **archive download-sw** or the **archive upload-sw** privileged EXEC command. For more information, see the "Working with Software Images" section on page 7-18.

Deleting Files

When you no longer need a file on a flash memory device, you can permanently delete it. To delete a file or directory from a specified flash device, use the **delete** [**/force**] [**/recursive**] [*filesystem***:**]**/***file-url* privileged EXEC command.

Caution When files are deleted, their contents cannot be recovered.

Use the **/recursive** keyword for deleting a directory and all subdirectories and the files contained in it. Use the **/force** keyword to suppress the prompting that confirms a deletion of each file in the directory. You are prompted only once at the beginning of this deletion process. Use the **/force** and **/recursive** keywords for deleting old software images that were installed by using the **archive download-sw** command but are no longer needed.

If you omit the *filesystem***:** option, the WMIC uses the default device specified by the **cd** command. For *file-url*, you specify the path (directory) and the name of the file to be deleted.

This example shows how to delete the file *myconfig* from the default flash memory device:

```
bridge# delete myconfig
```

Creating, Displaying, and Extracting tar Files

You can create a tar file and write files into it, list the files in a tar file, and extract the files from a tar file as described in the next sections.

Creating a tar File

To create a tar file and write files into it, use the following command in privileged EXEC mode:

archive tar /create *destination-url* **flash:/***file-url*

For *destination-url*, specify the destination URL alias for the local or network file system and the name of the tar file to create. These options are supported:

- For the local flash file system, the syntax is
  flash:/*file-url*
- For the File Transfer Protocol (FTP), the syntax is
  ftp:[[**//***username*[**:***password*]**@***location*]**/***directory*]**/***tar-filename***.tar**
- For the Remote Copy Protocol (RCP), the syntax is
  rcp:[[**//***username***@***location*]**/***directory*]**/***tar-filename***.tar**
- For the Trivial File Transfer Protocol (TFTP), the syntax is
  tftp:[[**//***location*]**/***directory*]**/***tar-filename***.tar**

The *tar-filename***.tar** is the tar file to be created.

For **flash:/***file-url*, specify the location on the local flash file system from which the new tar file is created. You can also specify an optional list of files or directories within the source directory to write to the new tar file. If none are specified, all files and directories at this level are written to the newly created tar file.

This example shows how to create a tar file. This command writes the contents of the *new-configs* directory on the local flash device to a file named *saved.tar* on the TFTP server at 172.20.10.30:

```
bridge# archive tar /create tftp://172.20.10.30/saved.tar flash:/new-configs
```

Displaying the Contents of a tar File

To display the contents of a tar file on the screen, use this privileged EXEC command:

archive tar /table *source-url*

For *source-url*, specify the source URL alias for the local or network file system. These options are supported:

- For the local flash file system, the syntax is
  flash:
- For the File Transfer Protocol (FTP), the syntax is
  ftp:[[**//***username*[**:***password*]**@***location*]**/***directory*]**/***tar-filename***.tar**
- For the Remote Copy Protocol (RCP), the syntax is
  rcp:[[**//***username***@***location*]**/***directory*]**/***tar-filename***.tar**
- For the Trivial File Transfer Protocol (TFTP), the syntax is
  tftp:[[**//***location*]**/***directory*]**/***tar-filename***.tar**

The *tar-filename***.tar** is the tar file to display.

You can also limit the display of the files by specifying an optional list of files or directories after the tar file; then only these files are displayed. If none are specified, all files and directories are displayed.

This example shows how to display the contents of the *c1200-k9w7-mx.122-8.JA.tar* file that is in flash memory:

```
bridge# archive tar /table flash:c1200-k9w7-mx.122-8.JA.tar
info (219 bytes)
c1400-k9w7-mx.122-11.JA/ (directory)
c1400-k9w7-mx.122-11.JA/html/ (directory)
c1400-k9w7-mx.122-11.JA/html/foo.html (0 bytes)
c1400-k9w7-mx.122-11.JA/c1200-k9w7-mx.122-8.JA.bin (610856 bytes)
c1400-k9w7-mx.122-11.JA/info (219 bytes)
info.ver (219 bytes)
```

This example shows how to display only the *c1200-k9w7-mx.122-8.JA/html* directory and its contents:

```
bridge# archive tar /table flash:c1200-k9w7-mx.122-8.JA/html
c1400-k9w7-mx.122-11.JA/html/ (directory)
c1400-k9w7-mx.122-11.JA/html/foo.html (0 bytes)
```

Extracting a tar File

To extract a tar file into a directory on the flash file system, use this privileged EXEC command:

archive tar /xtract *source-url* **flash:/***file-url*

For *source-url*, specify the source URL alias for the local or network file system. These options are supported:

- For the local flash file system, the syntax is
  flash:
- For the File Transfer Protocol (FTP), the syntax is
  ftp:[[**//**_username_[**:**_password_]@_location_]**/**_directory_]**/**_tar-filename_**.tar**
- For the Remote Copy Protocol (RCP), the syntax is
  rcp:[[**//**_username_@_location_]**/**_directory_]**/**_tar-filename_**.tar**
- For the Trivial File Transfer Protocol (TFTP), the syntax is
  tftp:[[**//**_location_]**/**_directory_]**/**_tar-filename_**.tar**

The _tar-filename_**.tar** is the tar file from which to extract files.

For **flash:/**_file-url_, specify the location on the local flash file system into which the tar file is extracted. You can also specify an optional list of files or directories within the tar file for extraction. If none are specified, all files and directories are extracted.

This example shows how to extract the contents of a tar file located on the TFTP server at 172.20.10.30. This command extracts just the _new-configs_ directory into the root directory on the local flash file system. The remaining files in the _saved.tar_ file are ignored.

```
bridge# archive tar /xtract tftp://172.20.10.30/saved.tar flash:/new-configs
```

Displaying the Contents of a File

To display the contents of any readable file, including a file on a remote file system, use the **more** [**/ascii** | **/binary** | **/ebcdic**] _file-url_ privileged EXEC command:

This example shows how to display the contents of a configuration file on a TFTP server:

```
bridge# more tftp://serverA/hampton/savedconfig
!
! Saved configuration on server
!
version 11.3
service timestamps log datetime localtime
service linenumber
service udp-small-servers
service pt-vty-logging
!

<output truncated>
```

Working with Configuration Files

This section describes how to create, load, and maintain configuration files. Configuration files contain commands entered to customize the function of the Cisco IOS software. To better benefit from these instructions, your WMIC contains a minimal default running configuration for interacting with the system software.

You can copy (_download_) configuration files from a TFTP, FTP, or RCP server to the running configuration of the WMIC for various reasons:

- To restore a backed-up configuration file.
- To use the configuration file for another bridge. For example, you might add another bridge to your network and want it to have a configuration similar to the original bridge. By copying the file to the new bridge, you can change the relevant parts rather than recreating the whole file.

- To load the same configuration commands on all the access points in your network so that all the access points have similar configurations.

You can copy (*upload*) configuration files from the WMIC to a file server by using TFTP, FTP, or RCP. You might perform this task to back up a current configuration file to a server before changing its contents so that you can later restore the original configuration file from the server.

The protocol you use depends on which type of server you are using. The FTP and RCP transport mechanisms provide faster performance and more reliable delivery of data than TFTP. These improvements are possible because FTP and RCP are built on and use the Transmission Control Protocol/Internet Protocol (TCP/IP) stack, which is connection oriented.

This section includes this information:

- Guidelines for Creating and Using Configuration Files, page 7-8
- Configuration File Types and Location, page 7-9
- Creating a Configuration File by Using a Text Editor, page 7-9
- Copying Configuration Files by Using TFTP, page 7-9
- Copying Configuration Files by Using FTP, page 7-11
- Copying Configuration Files by Using RCP, page 7-14
- Clearing Configuration Information, page 7-17

Guidelines for Creating and Using Configuration Files

Creating configuration files can aid in your WMIC configuration. Configuration files can contain some or all of the commands needed to configure one or more access points. For example, you might want to download the same configuration file to several access points that have the same hardware configuration.

Use these guidelines when creating a configuration file:

- If no passwords have been set on the WMIC, you must set them on each bridge by entering the **enable secret** *secret-password* global configuration command. Enter a blank line for this command. The password is saved in the configuration file as clear text.
- If passwords already exist, you cannot enter the **enable secret** *secret-password* global configuration command in the file because the password verification will fail. If you enter a password in the configuration file, the WMIC mistakenly attempts to execute the passwords as commands as it executes the file.
- The **copy** {**ftp:** | **rcp:** | **tftp:**} **system:running-config** privileged EXEC command loads the configuration files on the WMIC as if you were entering the commands at the command line. The WMIC does not erase the existing running configuration before adding the commands. If a command in the copied configuration file replaces a command in the existing configuration file, the existing command is erased. For example, if the copied configuration file contains a different IP address in a particular command than the existing configuration, the IP address in the copied configuration is used. However, some commands in the existing configuration might not be replaced or negated. In this case, the resulting configuration file is a mixture of the existing configuration file and the copied configuration file, with the copied configuration file having precedence.

  To restore a configuration file to an exact copy of a file stored on a server, copy the configuration file directly to the startup configuration (by using the **copy** {**ftp:** | **rcp:** | **tftp:**} **nvram:startup-config** privileged EXEC command), and reload the WMIC.

Configuration File Types and Location

Startup configuration files are used during system startup to configure the software. Running configuration files contain the current configuration of the software. The two configuration files can be different. For example, you might want to change the configuration for a short time period rather than permanently. In this case, you would change the running configuration but not save the configuration by using the **copy running-config startup-config** privileged EXEC command.

The running configuration is saved in DRAM; the startup configuration is stored in the NVRAM section of flash memory.

Creating a Configuration File by Using a Text Editor

When creating a configuration file, you must list commands logically so that the system can respond appropriately. This is one method of creating a configuration file:

Step 1 Copy an existing configuration from a WMIC to a server.

For more information, see the "Downloading the Configuration File by Using TFTP" section on page 7-10, the "Downloading a Configuration File by Using FTP" section on page 7-12, or the "Downloading a Configuration File by Using RCP" section on page 7-15.

Step 2 Open the configuration file in a text editor such as vi or emacs on UNIX or Notepad on a PC.

Step 3 Extract the portion of the configuration file with the desired commands, and save it in a new file.

Step 4 Copy the configuration file to the appropriate server location. For example, copy the file to the TFTP directory on the workstation (usually /tftpboot on a UNIX workstation).

Step 5 Make sure the permissions on the file are set to world-read.

Copying Configuration Files by Using TFTP

You can configure the WMIC by using configuration files you create, download from another device, or download from a TFTP server. You can copy (upload) configuration files to a TFTP server for storage.

This section includes this information:

- Preparing to Download or Upload a Configuration File by Using TFTP, page 7-9
- Downloading the Configuration File by Using TFTP, page 7-10
- Uploading the Configuration File by Using TFTP, page 7-11

Preparing to Download or Upload a Configuration File by Using TFTP

Before you begin downloading or uploading a configuration file by using TFTP, perform these tasks:

- Ensure that the workstation acting as the TFTP server is properly configured. On a Sun workstation, make sure that the /etc/inetd.conf file contains this line:

  ```
  tftp dgram udp wait root /usr/etc/in.tftpd in.tftpd -p -s /tftpboot
  ```

  Make sure that the /etc/services file contains this line:

```
tftp 69/udp
```

Note You must restart the inetd daemon after modifying the /etc/inetd.conf and /etc/services files. To restart the daemon, either stop the inetd process and restart it, or enter a **fastboot** command (on the SunOS 4.x) or a **reboot** command (on Solaris 2.x or SunOS 5.x). For more information on the TFTP daemon, refer to the documentation for your workstation.

- Ensure that the WMIC has a route to the TFTP server. The WMIC and the TFTP server must be in the same subnetwork if you do not have a router to route traffic between subnets. Check connectivity to the TFTP server by using the **ping** command.
- Ensure that the configuration file to be downloaded is in the correct directory on the TFTP server (usually /tftpboot on a UNIX workstation).
- For download operations, ensure that the permissions on the file are set correctly. The permission on the file should be world-read.
- Before uploading the configuration file, you might need to create an empty file on the TFTP server. To create an empty file, enter the **touch** *filename* command, where *filename* is the name of the file you will use when uploading it to the server.
- During upload operations, if you are overwriting an existing file (including an empty file, if you had to create one) on the server, ensure that the permissions on the file are set correctly. Permissions on the file should be world-write.

Downloading the Configuration File by Using TFTP

To configure the WMIC by using a configuration file downloaded from a TFTP server, follow these steps:

Step 1 Copy the configuration file to the appropriate TFTP directory on the workstation.

Step 2 Verify that the TFTP server is properly configured by referring to the "Preparing to Download or Upload a Configuration File by Using TFTP" section on page 7-9.

Step 3 Log in to the WMIC through a Telnet session.

Step 4 Download the configuration file from the TFTP server to configure the WMIC.

Specify the IP address or hostname of the TFTP server and the name of the file to download.

Use one of these privileged EXEC commands:

- **copy tftp:**[[[//*location*]/*directory*]/*filename*] **system:running-config**
- **copy tftp:**[[[//*location*]/*directory*]/*filename*] **nvram:startup-config**

The configuration file downloads, and the commands are executed as the file is parsed line-by-line.

This example shows how to configure the software from the file *tokyo-confg* at IP address 172.16.2.155:

```
bridge# copy tftp://172.16.2.155/tokyo-confg system:running-config
Configure using tokyo-confg from 172.16.2.155? [confirm] y
Booting tokyo-confg from 172.16.2.155:!!! [OK - 874/16000 bytes]
```

Uploading the Configuration File by Using TFTP

To upload a configuration file from a WMIC to a TFTP server for storage, follow these steps:

Step 1 Verify that the TFTP server is properly configured by referring to the "Preparing to Download or Upload a Configuration File by Using TFTP" section on page 7-9.

Step 2 Log in to the WMIC through a Telnet session.

Step 3 Upload the WMIC configuration to the TFTP server. Specify the IP address or hostname of the TFTP server and the destination filename.

Use one of these privileged EXEC commands:

- **copy system:running-config tftp:**[[[**//***location*]**/***directory*]**/***filename*]
- **copy nvram:startup-config tftp:**[[[**//***location*]**/***directory*]**/***filename*]

The file is uploaded to the TFTP server.

This example shows how to upload a configuration file from an WMIC to a TFTP server:

```
bridge# copy system:running-config tftp://172.16.2.155/tokyo-config
Write file tokyo-confg on host 172.16.2.155? [confirm] y
#
Writing tokyo-confg!!! [OK]
```

Copying Configuration Files by Using FTP

You can copy configuration files to or from an FTP server.

The FTP protocol requires a client to send a remote username and password on each FTP request to a server. When you copy a configuration file from the WMIC to a server by using FTP, the Cisco IOS software sends the first valid username in this list:

- The username specified in the **copy** command if a username is specified.
- The username set by the **ip ftp username** *username* global configuration command if the command is configured.
- Anonymous.

The WMIC sends the first valid password in this list:

- The password specified in the **copy** command if a password is specified.
- The password set by the **ip ftp password** *password* global configuration command if the command is configured.
- The WMIC forms a password named *username@apname.domain*. The variable *username* is the username associated with the current session, *apname* is the configured hostname, and *domain* is the domain of the WMIC.

The username and password must be associated with an account on the FTP server. If you are writing to the server, the FTP server must be properly configured to accept your FTP write request.

Use the **ip ftp username** and **ip ftp password** commands to specify a username and password for all copies. Include the username in the **copy** command if you want to specify only a username for that copy operation.

If the server has a directory structure, the configuration file is written to or copied from the directory associated with the username on the server. For example, if the configuration file resides in the home directory of a user on the server, specify that user's name as the remote username.

For more information, refer to the documentation for your FTP server.

This section includes this information:

- Preparing to Download or Upload a Configuration File by Using FTP, page 7-12
- Downloading a Configuration File by Using FTP, page 7-12
- Uploading a Configuration File by Using FTP, page 7-13

Preparing to Download or Upload a Configuration File by Using FTP

Before you begin downloading or uploading a configuration file by using FTP, perform these tasks:

- Ensure that the WMIC has a route to the FTP server. The WMIC and the FTP server must be in the same subnetwork if you do not have a router to route traffic between subnets. Check connectivity to the FTP server by using the **ping** command.
- If you are accessing the WMIC through a Telnet session and you do not have a valid username, make sure that the current FTP username is the one that you want to use for the FTP download. You can enter the **show users** privileged EXEC command to view the valid username. If you do not want to use this username, create a new FTP username by using the **ip ftp username** *username* global configuration command during all copy operations. The new username is stored in NVRAM. If you are accessing the WMIC through a Telnet session and you have a valid username, this username is used, and you do not need to set the FTP username. Include the username in the **copy** command if you want to specify a username for only that copy operation.
- When you upload a configuration file to the FTP server, it must be properly configured to accept the write request from the user on the WMIC.

For more information, refer to the documentation for your FTP server.

Downloading a Configuration File by Using FTP

To download a configuration file by using FTP, follow these steps, beginning in privileged EXEC mode:

	Command	Purpose
Step 1		Verify that the RCP server is properly configured by referring to the "Preparing to Download or Upload a Configuration File by Using RCP" section on page 7-15.
Step 2		Log in to the WMIC through a Telnet session.
Step 1	**configure terminal**	Enters global configuration mode on the WMIC. This step is required only if you override the default remote username or password (see Steps 4, 5, and 6).
Step 2	**ip ftp username** *username*	(Optional) Changes the default remote username.
Step 3	**ip ftp password** *password*	(Optional) Changes the default password.

	Command	Purpose
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy ftp:**[[[**//**[*username*[**:***password*]**@**]*location*]**/***directory*] **/***filename*] **system:running-config** or **copy ftp:**[[[**//**[*username*[**:***password*]**@**]*location*]**/***directory*] **/***filename*] **nvram:startup-config**	Using FTP, copies the configuration file from a network server to the running configuration or to the startup configuration file.

This example shows how to copy a configuration file named *host1-confg* from the *netadmin1* directory on the remote server with an IP address of 172.16.101.101 and to load and run those commands on the WMIC:

```
bridge# copy ftp://netadmin1:mypass@172.16.101.101/host1-confg system:running-config
Configure using host1-confg from 172.16.101.101? [confirm]
Connected to 172.16.101.101
Loading 1112 byte file host1-confg:![OK]
bridge#
%SYS-5-CONFIG: Configured from host1-config by ftp from 172.16.101.101
```

This example shows how to specify a remote username of *netadmin1*. The software copies the configuration file *host2-confg* from the *netadmin1* directory on the remote server with an IP address of 172.16.101.101 to the WMIC startup configuration.

```
bridge# configure terminal
bridge(config)# ip ftp username netadmin1
bridge(config)# ip ftp password mypass
bridge(config)# end
bridge# copy ftp: nvram:startup-config
Address of remote host [255.255.255.255]? 172.16.101.101
Name of configuration file[rtr2-confg]? host2-confg
Configure using host2-confg from 172.16.101.101?[confirm]
Connected to 172.16.101.101
Loading 1112 byte file host2-confg:![OK]
[OK]
bridge#
%SYS-5-CONFIG_NV:Non-volatile store configured from host2-config by ftp from
172.16.101.101
```

Uploading a Configuration File by Using FTP

To upload a configuration file by using FTP, follow these steps, beginning in privileged EXEC mode:

	Command	Purpose
Step 1		Verify that the RCP server is properly configured by referring to the "Preparing to Download or Upload a Configuration File by Using RCP" section on page 7-15.
Step 2		Log in to the WMIC through a Telnet session.
Step 3	**configure terminal**	Enters global configuration mode. This step is required only if you override the default remote username or password (see Steps 4, 5, and 6).

	Command	Purpose
Step 4	**ip ftp username** *username*	(Optional) Changes the default remote username.
Step 5	**ip ftp password** *password*	(Optional) Changes the default password.
Step 6	**end**	Returns to privileged EXEC mode.
Step 7	**copy system:running-config ftp:**[[[**//**[*username*[**:***password*]**@**]*location*]**/***directory*] **/***filename*] or **copy nvram:startup-config ftp:**[[[**//**[*username*[**:***password*]**@**]*location*]**/***directory*] **/***filename*]	Using FTP, stores the WMIC running or startup configuration file to the specified location.

This example shows how to copy the running configuration file named *ap2-confg* to the *netadmin1* directory on the remote host with an IP address of 172.16.101.101:

```
bridge# copy system:running-config ftp://netadmin1:mypass@172.16.101.101/ap2-confg
Write file ap2-confg on host 172.16.101.101?[confirm]
Building configuration...[OK]
Connected to 172.16.101.101
bridge#
```

This example shows how to store a startup configuration file on a server by using FTP to copy the file:

```
bridge# configure terminal
bridge(config)# ip ftp username netadmin2
bridge(config)# ip ftp password mypass
bridge(config)# end
bridge# copy nvram:startup-config ftp:
Remote host[]? 172.16.101.101
Name of configuration file to write [ap2-confg]?
Write file ap2-confg on host 172.16.101.101?[confirm]
![OK]
```

Copying Configuration Files by Using RCP

The Remote Copy Protocol (RCP) provides another method of downloading, uploading, and copying configuration files between remote hosts and the WMIC. Unlike TFTP, which uses User Datagram Protocol (UDP), a connectionless protocol, RCP uses TCP, which is connection-oriented.

To use RCP to copy files, the server from or to which you will be copying files must support RCP. The RCP copy commands rely on the rsh server (or daemon) on the remote system. To copy files by using RCP, you do not need to create a server for file distribution as you do with TFTP. You only need to have access to a server that supports the remote shell (rsh). (Most UNIX systems support rsh.) Because you are copying a file from one place to another, you must have read permission on the source file and write permission on the destination file. If the destination file does not exist, RCP creates it for you.

The RCP requires a client to send a remote username with each RCP request to a server. When you copy a configuration file from the WMIC to a server, the Cisco IOS software sends the first valid username in this list:

- The username specified in the **copy** command if a username is specified.
- The username set by the **ip rcmd remote-username** *username* global configuration command if the command is configured.

- The remote username associated with the current TTY (terminal) process. For example, if the user is connected to the router through Telnet and was authenticated through the **username** command, the WMIC software sends the Telnet username as the remote username.
- The WMIC hostname.

For a successful RCP copy request, you must define an account on the network server for the remote username. If the server has a directory structure, the configuration file is written to or copied from the directory associated with the remote username on the server. For example, if the configuration file is in the home directory of a user on the server, specify that user's name as the remote username.

This section includes this information:

- Preparing to Download or Upload a Configuration File by Using RCP, page 7-15
- Downloading a Configuration File by Using RCP, page 7-15
- Uploading a Configuration File by Using RCP, page 7-16

Preparing to Download or Upload a Configuration File by Using RCP

Before you begin downloading or uploading a configuration file by using RCP, perform these tasks:

- Ensure that the workstation acting as the RCP server supports the remote shell (rsh).
- Ensure that the WMIC has a route to the RCP server. The WMIC and the server must be in the same subnetwork if you do not have a router to route traffic between subnets. Check connectivity to the RCP server by using the **ping** command.
- If you are accessing the WMIC through a Telnet session and you do not have a valid username, make sure that the current RCP username is the one that you want to use for the RCP download. You can enter the **show users** privileged EXEC command to view the valid username. If you do not want to use this username, create a new RCP username by using the **ip rcmd remote-username** *username* global configuration command to be used during all copy operations. The new username is stored in NVRAM. If you are accessing the WMIC through a Telnet session and you have a valid username, this username is used, and you do not need to set the RCP username. Include the username in the **copy** command if you want to specify a username for only that copy operation.
- When you upload a file to the RCP server, it must be properly configured to accept the RCP write request from the user on the WMIC. For UNIX systems, you must add an entry to the .rhosts file for the remote user on the RCP server. For example, suppose that the WMIC contains these configuration lines:

  ```
  hostname ap1
  ip rcmd remote-username User0
  ```

  If the WMIC IP address translates to *ap1.company.com*, the .rhosts file for User0 on the RCP server should contain this line:

  ```
  ap1.company.com ap1
  ```

For more information, refer to the documentation for your RCP server.

Downloading a Configuration File by Using RCP

To download a configuration file by using FTP, follow these steps, beginning in privileged EXEC mode:

	Command	Purpose
Step 1		Verify that the RCP server is properly configured by referring to the "Preparing to Download or Upload a Configuration File by Using RCP" section on page 7-15.
Step 2		Log in to the WMIC through a Telnet session.
Step 3	**configure terminal**	Enters global configuration mode. This step is required only if you override the default remote username (see Steps 4 and 5).
Step 4	**ip rcmd remote-username** *username*	(Optional) Specifies the remote username.
Step 5	**end**	Returns to privileged EXEC mode.
Step 6	**copy rcp:**[[[//[*username*@]*location*]/*directory*]/*filename*] **system:running-config** or **copy rcp:**[[[//[*username*@]*location*]/*directory*]/*filename*] **nvram:startup-config**	Using RCP, copies the configuration file from a network server to the running configuration or to the startup configuration file.

This example shows how to copy a configuration file named *host1-confg* from the *netadmin1* directory on the remote server with an IP address of 172.16.101.101 and load and run those commands on the WMIC:

```
bridge# copy rcp://netadmin1@172.16.101.101/host1-confg system:running-config
Configure using host1-confg from 172.16.101.101? [confirm]
Connected to 172.16.101.101
Loading 1112 byte file host1-confg:![OK]
bridge#
%SYS-5-CONFIG: Configured from host1-config by rcp from 172.16.101.101
```

This example shows how to specify a remote username of *netadmin1*. Then it copies the configuration file *host2-confg* from the *netadmin1* directory on the remote server with an IP address of 172.16.101.101 to the startup configuration:

```
bridge# configure terminal
bridge(config)# ip rcmd remote-username netadmin1
bridge(config)# end
bridge# copy rcp: nvram:startup-config
Address of remote host [255.255.255.255]? 172.16.101.101
Name of configuration file[rtr2-confg]? host2-confg
Configure using host2-confg from 172.16.101.101?[confirm]
Connected to 172.16.101.101
Loading 1112 byte file host2-confg:![OK]
[OK]
bridge#
%SYS-5-CONFIG_NV:Non-volatile store configured from host2-config by rcp from
172.16.101.101
```

Uploading a Configuration File by Using RCP

To upload a configuration file by using RCP, follow these steps, beginning in privileged EXEC mode:

	Command	Purpose
Step 1		Verify that the RCP server is properly configured by referring to the "Preparing to Download or Upload a Configuration File by Using RCP" section on page 7-15.
Step 2		Log in to the WMIC through a Telnet session.
Step 3	**configure terminal**	Enters global configuration mode. This step is required only if you override the default remote username (see Steps 4 and 5).
Step 4	**ip rcmd remote-username** *username*	(Optional) Specifies the remote username.
Step 5	**end**	Returns to privileged EXEC mode.
Step 6	**copy system:running-config rcp:**[[[**//**[*username*@]*location*]**/***directory*]**/***filename*] or **copy nvram:startup-config rcp:**[[[**//**[*username*@]*location*]**/***directory*]**/***filename*]	Using RCP, copies the configuration file from an WMIC running or startup configuration file to a network server.

This example shows how to copy the running configuration file named *ap2-confg* to the *netadmin1* directory on the remote host with an IP address of 172.16.101.101:

```
bridge# copy system:running-config rcp://netadmin1@172.16.101.101/ap2-confg
Write file br-confg on host 172.16.101.101?[confirm]
Building configuration...[OK]
Connected to 172.16.101.101
bridge#
```

This example shows how to store a startup configuration file on a server:

```
bridge# configure terminal
bridge(config)# ip rcmd remote-username netadmin2
bridge(config)# end
bridge# copy nvram:startup-config rcp:
Remote host[]? 172.16.101.101
Name of configuration file to write [ap2-confg]?
Write file ap2-confg on host 172.16.101.101?[confirm]
![OK]
```

Clearing Configuration Information

This section describes how to clear configuration information.

Deleting a Stored Configuration File

Caution You cannot restore a file after it has been deleted.

To delete a saved configuration from flash memory, use the **delete flash:***filename* privileged EXEC command. Depending on the setting of the **file prompt** global configuration command, you might be prompted for confirmation before you delete a file. By default, the WMIC prompts for confirmation on destructive file operations. For more information about the **file prompt** command, refer to the *Cisco IOS Command Reference for Release 12.1*.

Working with Software Images

This section describes how to archive (download and upload) software image files, which contain the system software, Cisco IOS code, radio firmware, and the web management HTML files.

You download an WMIC image file from a TFTP, FTP, or RCP server to upgrade the WMIC software. You upload an WMIC image file to a TFTP, FTP, or RCP server for backup purposes. You can use this uploaded image for future downloads to the same WMIC or another of the same type.

The protocol you use depends on which type of server you are using. The FTP and RCP transport mechanisms provide faster performance and more reliable delivery of data than TFTP. These improvements are possible because FTP and RCP are built on and use the Transmission Control Protocol/Internet Protocol (TCP/IP) stack, which is connection-oriented.

This section includes this information:

- Image Location on the WMIC, page 7-18
- tar File Format of Images on a Server or Cisco.com, page 7-19
- Copying Image Files by Using TFTP, page 7-19
- Copying Image Files by Using FTP, page 7-22
- Copying Image Files by Using RCP, page 7-27

Note For a list of software images and supported upgrade paths, refer to the release notes for your WMIC.

Image Location on the WMIC

The Cisco IOS image is stored in a directory that shows the version number. A subdirectory contains the HTML files needed for web management. The image is stored on the system board flash memory (flash:).

You can use the **show version** privileged EXEC command to see the software version that is currently running on your WMIC. In the display, check the line that begins with `System image file is...` It shows the directory name in flash memory where the image is stored.

You can also use the **dir** *filesystem***:** privileged EXEC command to see the directory names of other software images you might have stored in flash memory.

tar File Format of Images on a Server or Cisco.com

Software images located on a server or downloaded from Cisco.com are provided in a tar file format, which contains these files:

- *info* file (The info file is always at the beginning of the tar file and contains information about the files within it.)
- IOS image
- Web management files needed by the HTTP server on the WMIC
- radio firmware 6500.img file
- *info.ver* file

  The info.ver file is always at the end of the tar file and contains the same information as the info file. Because it is the last file in the tar file, its existence means that all files in the image have been downloaded.

Note The tar file sometimes ends with an extension other than *.tar*.

Copying Image Files by Using TFTP

You can download an WMIC image from a TFTP server or upload the image from the WMIC to a TFTP server.

You download an WMIC image file from a server to upgrade the WMIC software. You can overwrite the current image with the new one.

You upload an WMIC image file to a server for backup purposes; this uploaded image can be used for future downloads to the same or another device of the same type.

This section includes this information:

- Preparing to Download or Upload an Image File by Using TFTP, page 7-19
- Downloading an Image File by Using TFTP, page 7-20
- Uploading an Image File by Using TFTP, page 7-22

Preparing to Download or Upload an Image File by Using TFTP

Before you begin downloading or uploading an image file by using TFTP, perform these tasks:

- Ensure that the workstation acting as the TFTP server is properly configured. On a Sun workstation, make sure that the /etc/inetd.conf file contains this line:

  ```
  tftp dgram udp wait root /usr/etc/in.tftpd in.tftpd -p -s /tftpboot
  ```

  Make sure that the /etc/services file contains this line:

  ```
  tftp 69/udp
  ```

Note You must restart the inetd daemon after modifying the /etc/inetd.conf and /etc/services files. To restart the daemon, either stop the inetd process and restart it, or enter a **fastboot** command (on the SunOS 4.x) or a **reboot** command (on Solaris 2.x or SunOS 5.x). For more information on the TFTP daemon, refer to the documentation for your workstation.

- Ensure that the WMIC has a route to the TFTP server. The WMIC and the TFTP server must be in the same subnetwork if you do not have a router to route traffic between subnets. Check connectivity to the TFTP server by using the **ping** command.
- Ensure that the image to be downloaded is in the correct directory on the TFTP server (usually /tftpboot on a UNIX workstation).
- For download operations, ensure that the permissions on the file are set correctly. The permission on the file should be world-read.
- Before uploading the image file, you might need to create an empty file on the TFTP server. To create an empty file, enter the **touch** *filename* command, where *filename* is the name of the file you will use when uploading the image to the server.
- During upload operations, if you are overwriting an existing file (including an empty file, if you had to create one) on the server, ensure that the permissions on the file are set correctly. Permissions on the file should be world-write.

Downloading an Image File by Using TFTP

You can download a new image file and replace the current image or keep the current image.

Caution For the download and upload algorithms to operate properly, do *not* rename image directories.

To download a new image from a TFTP server and overwrite the existing image, follow these steps, beginning in privileged EXEC mode:

	Command	Purpose
Step 1	.	Copy the image to the appropriate TFTP directory on the workstation. Make sure the TFTP server is properly configured; see the "Preparing to Download or Upload an Image File by Using TFTP" section on page 7-19
Step 2		Log in to the WMIC through a Telnet session.

	Command	Purpose
Step 3	**archive download-sw /overwrite /reload tftp:**[[**//***location*]**/***directory*]**/***image-name*	Downloads the image file from the TFTP server to the WMIC, and overwrite the current image. • The **/overwrite** option overwrites the software image in flash with the downloaded image. • The **/reload** option reloads the system after downloading the image unless the configuration has been changed and not saved. • For *location*, specify the IP address of the TFTP server. • For *directory***/***image-name*, specify the directory (optional) and the image to download. Directory and image names are case sensitive.
Step 4	**archive download-sw /leave-old-sw /reload tftp:**[[**//***location*]**/***directory*]**/***image-name*	Downloads the image file from the TFTP server to the WMIC, and keep the current image. • The **/leave-old-sw** option keeps the old software version after a download. • The **/reload** option reloads the system after downloading the image unless the configuration has been changed and not saved. • For *location*, specify the IP address of the TFTP server. • For *directory***/***image-name*, specify the directory (optional) and the image to download. Directory and image names are case sensitive.

Note To avoid an unsuccessful download, use the **archive download-sw /safe** command, which downloads the image first and does not delete the current running version until the download succeeds.

The download algorithm verifies that the image is appropriate for the WMIC model and that enough DRAM is present, or it aborts the process and reports an error. If you specify the **/overwrite** option, the download algorithm removes the existing image on the flash device whether or not it is the same as the new one, downloads the new image, and then reloads the software.

Note If the flash device has sufficient space to hold two images and you want to overwrite one of these images with the same version, you must specify the **/overwrite** option.

If you specify the **/leave-old-sw**, the existing files are not removed. If there is not enough space to install the new image and keep the current running image, the download process stops, and an error message is displayed.

The algorithm installs the downloaded image on the system board flash device (flash:). The image is placed into a new directory named with the software version string, and the system boot path variable is updated to point to the newly installed image.

If you kept the old image during the download process (you specified the **/leave-old-sw** keyword), you can remove it by entering the **delete /force /recursive** *filesystem***:/***file-url* privileged EXEC command. For *filesystem*, use **flash:** for the system board flash device. For *file-url*, enter the directory name of the old image. All the files in the directory and the directory are removed.

Uploading an Image File by Using TFTP

You can upload an image from the WMIC to a TFTP server. You can later download this image to the WMIC or to another WMIC of the same type.

Caution For the download and upload algorithms to operate properly, do *not* rename image directories.

Beginning in privileged EXEC mode, follow these steps to upload an image to a TFTP server:

	Command	Purpose
Step 1		Make sure the TFTP server is properly configured; see the "Preparing to Download or Upload an Image File by Using TFTP" section on page 7-19.
Step 1		Log in to the WMIC through a Telnet session.
Step 2	**archive upload-sw tftp:**[[//*location*]/*directory*]/*image-name*.**tar**	Uploads the currently running WMIC image to the TFTP server. • For *location*, specify the IP address of the TFTP server. • For *directory*/*image-name*.**tar**, specify the directory (optional) and the name of the software image to be uploaded. Directory and image names are case sensitive. The *image-name*.**tar** is the name of the software image to be stored on the server.

The **archive upload-sw** privileged EXEC command builds an image file on the server by uploading these files in order: info, the IOS image, the HTML files, and info.ver. After these files are uploaded, the upload algorithm creates the tar file format.

Copying Image Files by Using FTP

You can download a WMIC image from an FTP server or upload the image from the WMIC to an FTP server.

You download a WMIC image file from a server to upgrade the WMIC software. You can overwrite the current image with the new one or keep the current image after a download.

You upload an WMIC image file to a server for backup purposes. You can use this uploaded image for future downloads to the WMIC or another device of the same type.

This section includes this information:

- Preparing to Download or Upload an Image File by Using FTP, page 7-22
- Downloading an Image File by Using FTP, page 7-23
- Uploading an Image File by Using FTP, page 7-26

Preparing to Download or Upload an Image File by Using FTP

You can copy images files to or from an FTP server.

The FTP protocol requires a client to send a remote username and password on each FTP request to a server. When you copy an image file from the WMIC to a server by using FTP, the Cisco IOS software sends the first valid username in this list:

- The username specified in the **archive download-sw** or **archive upload-sw** privileged EXEC command if a username is specified.
- The username set by the **ip ftp username** *username* global configuration command if the command is configured.
- Anonymous.

The WMIC sends the first valid password in this list:

- The password specified in the **archive download-sw** or **archive upload-sw** privileged EXEC command if a password is specified.
- The password set by the **ip ftp password** *password* global configuration command if the command is configured.
- The WMIC forms a password named *username@apname.domain*. The variable *username* is the username associated with the current session, ap*name* is the configured hostname, and *domain* is the domain of the WMIC.

The username and password must be associated with an account on the FTP server. If you are writing to the server, the FTP server must be properly configured to accept the FTP write request from you.

Use the **ip ftp username** and **ip ftp password** commands to specify a username and password for all copies. Include the username in the **archive download-sw** or **archive upload-sw** privileged EXEC command if you want to specify a username only for that operation.

If the server has a directory structure, the image file is written to or copied from the directory associated with the username on the server. For example, if the image file resides in the home directory of a user on the server, specify that user's name as the remote username.

Before you begin downloading or uploading an image file by using FTP, perform these tasks:

- Ensure that the WMIC has a route to the FTP server. The WMIC and the FTP server must be in the same subnetwork if you do not have a router to route traffic between subnets. Verify connectivity to the FTP server by using the **ping** command.
- If you are accessing the WMIC through a Telnet session and you do not have a valid username, make sure that the current FTP username is the one that you want to use for the FTP download. You can enter the **show users** privileged EXEC command to view the valid username. If you do not want to use this username, create a new FTP username by using the **ip ftp username** *username* global configuration command. This new name will be used during all archive operations. The new username is stored in NVRAM. If you are accessing the WMIC through a Telnet session and you have a valid username, this username is used, and you do not need to set the FTP username. Include the username in the **archive download-sw** or **archive upload-sw** privileged EXEC command if you want to specify a username for that operation only.
- When you upload an image file to the FTP server, it must be properly configured to accept the write request from the user on the WMIC.

For more information, refer to the documentation for your FTP server.

Downloading an Image File by Using FTP

You can download a new image file and overwrite the current image or keep the current image.

⚠ **Caution** For the download and upload algorithms to operate properly, do *not* rename image directories.

Beginning in privileged EXEC mode, follow Steps 1 through 7 to download a new image from an FTP server and overwrite the existing image. To keep the current image, skip Step 7.

	Command	Purpose
Step 1		Verify that the FTP server is properly configured by referring to the "Preparing to Download or Upload an Image File by Using FTP" section on page 7-22.
Step 2		Log in to the WMIC through a Telnet session.
Step 3	**configure terminal**	Enters global configuration mode. This step is required only if you override the default remote username or password (see Steps 4, 5, and 6).
Step 4	**ip ftp username** *username*	(Optional) Changes the default remote username.
Step 5	**ip ftp password** *password*	(Optional) Changes the default password.
Step 6	**end**	Returns to privileged EXEC mode.

	Command	Purpose
Step 7	**archive download-sw /overwrite /reload ftp:**[[**//***username*[**:***password*]**@***location*]**/***directory*]**/***image-name***.tar**	Downloads the image file from the FTP server to the WMIC, and overwrite the current image. • The **/overwrite** option overwrites the software image in flash with the downloaded image. • The **/reload** option reloads the system after downloading the image unless the configuration has been changed and not saved. • For **//***username*[**:***password*], specify the username and password; these must be associated with an account on the FTP server. For more information, see the "Preparing to Download or Upload an Image File by Using FTP" section on page 7-22. • For **@***location*, specify the IP address of the FTP server. • For *directory***/***image-name***.tar**, specify the directory (optional) and the image to download. Directory and image names are case sensitive.
Step 8	**archive download-sw /leave-old-sw /reload ftp:**[[**//***username*[**:***password*]**@***location*]**/***directory*]**/***image-name***.tar**	Downloads the image file from the FTP server to the WMIC, and keep the current image. • The **/leave-old-sw** option keeps the old software version after a download. • The **/reload** option reloads the system after downloading the image unless the configuration has been changed and not saved. • For **//***username*[**:***password*], specify the username and password. These must be associated with an account on the FTP server. For more information, see the "Preparing to Download or Upload an Image File by Using FTP" section on page 7-22. • For **@***location*, specify the IP address of the FTP server. • For *directory***/***image-name***.tar**, specify the directory (optional) and the image to download. Directory and image names are case sensitive.

Note To avoid an unsuccessful download, use the **archive download-sw /safe** command, which downloads the image first and does not delete the current running version until the download succeeds.

The download algorithm verifies that the image is appropriate for the WMIC model and that enough DRAM is present, or it aborts the process and reports an error. If you specify the **/overwrite** option, the download algorithm removes the existing image on the flash device, whether or not it is the same as the new one, downloads the new image, and then reloads the software.

Note If the flash device has sufficient space to hold two images and you want to overwrite one of these images with the same version, you must specify the **/overwrite** option.

If you specify the **/leave-old-sw**, the existing files are not removed. If there is not enough space to install the new image and keep the running image, the download process stops, and an error message is displayed.

The algorithm installs the downloaded image onto the system board flash device (flash:). The image is placed into a new directory named with the software version string, and the BOOT path-list is updated to point to the newly installed image. Use the privileged EXEC mode **show boot** command to display boot attributes, and use the global configuration **boot** command to change the boot attributes.

If you kept the old image during the download process (you specified the **/leave-old-sw** keyword), you can remove it by entering the **delete /force /recursive** *filesystem***:/***file-url* privileged EXEC command. For *filesystem*, use **flash:** for the system board flash device. For *file-url*, enter the directory name of the old software image. All the files in the directory and the directory are removed.

Uploading an Image File by Using FTP

You can upload an image from the WMIC to an FTP server. You can later download this image to the same WMIC or to another WMIC of the same type.

Caution For the download and upload algorithms to operate properly, do *not* rename image directories.

The upload feature is available only if the HTML pages associated with the Cluster Management Suite (CMS) have been installed with the existing image.

Beginning in privileged EXEC mode, follow these steps to upload an image to an FTP server:

	Command	Purpose
Step 1		Verify that the FTP server is properly configured by referring to the "Preparing to Download or Upload a Configuration File by Using FTP" section on page 7-12.
Step 2		Log in to the WMIC through a Telnet session.
Step 3	**configure terminal**	Enters global configuration mode. This step is required only if you override the default remote username or password (see Steps 4, 5, and 6).
Step 4	**ip ftp username** *username*	(Optional) Changes the default remote username.
Step 5	**ip ftp password** *password*	(Optional) Changes the default password.

	Command	Purpose
Step 6	**end**	Returns to privileged EXEC mode.
Step 7	**archive upload-sw ftp:**[[**//**[*username*[**:***password*]**@**]*location*]**/***directory*]**/** *image-name***.tar**	Uploads the currently running WMIC image to the FTP server. • For **//***username***:***password*, specify the username and password. These must be associated with an account on the FTP server. For more information, see the "Preparing to Download or Upload an Image File by Using FTP" section on page 7-22. • For **@***location*, specify the IP address of the FTP server. • For **/***directory***/***image-name***.tar**, specify the directory (optional) and the name of the software image to be uploaded. Directory and image names are case sensitive. The *image-name***.tar** is the name of the software image to be stored on the server.

The **archive upload-sw** command builds an image file on the server by uploading these files in order: info, the IOS image, the HTML files, and info.ver. After these files are uploaded, the upload algorithm creates the tar file format.

Copying Image Files by Using RCP

You can download a WMIC image from an RCP server or upload the image from the WMIC to an RCP server.

You download a WMIC image file from a server to upgrade the WMIC software. You can overwrite the current image with the new one or keep the current image after a download.

You upload a WMIC image file to a server for backup purposes. You can use this uploaded image for future downloads to the same WMIC or another device of the same type.

This section includes this information:

- Preparing to Download or Upload an Image File by Using RCP, page 7-27
- Downloading an Image File by Using RCP, page 7-29
- Uploading an Image File by Using RCP, page 7-31

Preparing to Download or Upload an Image File by Using RCP

RCP provides another method of downloading and uploading image files between remote hosts and the WMIC. Unlike TFTP, which uses User Datagram Protocol (UDP), a connectionless protocol, RCP uses TCP, which is connection-oriented.

To use RCP to copy files, the server from or to which you will be copying files must support RCP. The RCP copy commands rely on the rsh server (or daemon) on the remote system. To copy files by using RCP, you do not need to create a server for file distribution as you do with TFTP. You only need to have access to a server that supports the remote shell (rsh). (Most UNIX systems support rsh.) Because you are copying a file from one place to another, you must have read permission on the source file and write permission on the destination file. If the destination file does not exist, RCP creates it for you.

RCP requires a client to send a remote username on each RCP request to a server. When you copy an image from the WMIC to a server by using RCP, the Cisco IOS software sends the first valid username in this list:

- The username specified in the **archive download-sw** or **archive upload-sw** privileged EXEC command if a username is specified.
- The username set by the **ip rcmd remote-username** *username* global configuration command if the command is entered.
- The remote username associated with the current TTY (terminal) process. For example, if the user is connected to the router through Telnet and was authenticated through the **username** command, the WMIC software sends the Telnet username as the remote username.
- The WMIC hostname.

For the RCP copy request to execute successfully, an account must be defined on the network server for the remote username. If the server has a directory structure, the image file is written to or copied from the directory associated with the remote username on the server. For example, if the image file resides in the home directory of a user on the server, specify that user's name as the remote username.

Before you begin downloading or uploading an image file by using RCP, do these tasks:

- Ensure that the workstation acting as the RCP server supports the remote shell (rsh).
- Ensure that the WMIC has a route to the RCP server. The WMIC and the server must be in the same subnetwork if you do not have a router to route traffic between subnets. Check connectivity to the RCP server by using the **ping** command.
- If you are accessing the WMIC through a Telnet session and you do not have a valid username, make sure that the current RCP username is the one that you want to use for the RCP download. You can enter the **show users** privileged EXEC command to view the valid username. If you do not want to use this username, create a new RCP username by using the **ip rcmd remote-username** *username* global configuration command to be used during all archive operations. The new username is stored in NVRAM. If you are accessing the WMIC through a Telnet session and you have a valid username, this username is used, and there is no need to set the RCP username. Include the username in the **archive download-sw** or **archive upload-sw** privileged EXEC command if you want to specify a username only for that operation.
- When you upload an image to the RCP to the server, it must be properly configured to accept the RCP write request from the user on the WMIC. For UNIX systems, you must add an entry to the .rhosts file for the remote user on the RCP server. For example, suppose the WMIC contains these configuration lines:

  ```
  hostname ap1
  ip rcmd remote-username User0
  ```

  If the WMIC IP address translates to *ap1.company.com*, the .rhosts file for User0 on the RCP server should contain this line:

  ```
  ap1.company.com ap1
  ```

For more information, refer to the documentation for your RCP server.

Downloading an Image File by Using RCP

You can download a new image file and replace or keep the current image.

Caution For the download and upload algorithms to operate properly, do *not* rename image directories.

Beginning in privileged EXEC mode, follow Steps 1 through 6 to download a new image from an RCP server and overwrite the existing image. To keep the current image, skip Step 6.

	Command	Purpose
Step 1		Verify that the RCP server is properly configured by referring to the "Preparing to Download or Upload an Image File by Using RCP" section on page 7-27.
Step 2		Log in to the WMIC through a Telnet session.
Step 3	**configure terminal**	Enters global configuration mode. This step is required only if you override the default remote username (see Steps 4 and 5).
Step 4	**ip rcmd remote-username** *username*	(Optional) Specifies the remote username.
Step 5	**end**	Returns to privileged EXEC mode.
Step 6	**archive download-sw /overwrite /reload rcp:**[[[**//**[*username*@]*location*]**/***directory*]**/***image-name***.tar**]	Downloads the image file from the RCP server to the WMIC, and overwrite the current image. • The **/overwrite** option overwrites the software image in flash with the downloaded image. • The **/reload** option reloads the system after downloading the image unless the configuration has been changed and not saved. • For **//***username*, specify the username. For the RCP copy request to execute successfully, an account must be defined on the network server for the remote username. For more information, see the "Preparing to Download or Upload an Image File by Using RCP" section on page 7-27. • For @*location*, specify the IP address of the RCP server. • For **/***directory***/***image-name***.tar**, specify the directory (optional) and the image to download. Directory and image names are case sensitive.

	Command	Purpose
Step 7	**archive download-sw /leave-old-sw /reload rcp:**[[[**//**[*username*@]*location*]**/***directory*]**/***image-name***.tar**]	Downloads the image file from the RCP server to the WMIC, and keep the current image. • The **/leave-old-sw** option keeps the old software version after a download. • The **/reload** option reloads the system after downloading the image unless the configuration has been changed and not saved. • For **//***username*, specify the username. For the RCP copy request to execute, an account must be defined on the network server for the remote username. For more information, see the "Preparing to Download or Upload an Image File by Using RCP" section on page 7-27. • For @*location*, specify the IP address of the RCP server. • For **/***directory*]**/***image-name***.tar**, specify the directory (optional) and the image to download. Directory and image names are case sensitive.

Note To avoid an unsuccessful download, use the **archive download-sw /safe** command, which downloads the image first and does not delete the current running version until the download succeeds.

The download algorithm verifies that the image is appropriate for the WMIC model and that enough DRAM is present, or it aborts the process and reports an error. If you specify the **/overwrite** option, the download algorithm removes the existing image on the flash device whether or not it is the same as the new one, downloads the new image, and then reloads the software.

Note If the flash device has sufficient space to hold two images and you want to overwrite one of these images with the same version, you must specify the **/overwrite** option.

If you specify the **/leave-old-sw**, the existing files are not removed. If there is not enough room to install the new image an keep the running image, the download process stops, and an error message is displayed.

The algorithm installs the downloaded image onto the system board flash device (flash:). The image is placed into a new directory named with the software version string, and the BOOT environment variable is updated to point to the newly installed image.

If you kept the old software during the download process (you specified the **/leave-old-sw** keyword), you can remove it by entering the **delete /force /recursive** *filesystem***:/***file-url* privileged EXEC command. For *filesystem*, use **flash:** for the system board flash device. For *file-url*, enter the directory name of the old software image. All the files in the directory and the directory are removed.

Uploading an Image File by Using RCP

You can upload an image from the WMIC to an RCP server. You can later download this image to the same WMIC or to another WMIC of the same type.

Caution For the download and upload algorithms to operate properly, do *not* rename image directories.

The upload feature is available only if the HTML pages associated with the Cluster Management Suite (CMS) have been installed with the existing image.

Beginning in privileged EXEC mode, follow these steps to upload an image to an RCP server:

	Command	Purpose
Step 1		Verify that the RCP server is properly configured by referring to the "Preparing to Download or Upload an Image File by Using RCP" section on page 7-27.
Step 2		Log in to the WMIC through a Telnet session.
Step 3	**configure terminal**	Enters global configuration mode. This step is required only if you override the default remote username (see Steps 4 and 5).
Step 4	**ip rcmd remote-username** *username*	(Optional) Specifies the remote username.
Step 5	**end**	Returns to privileged EXEC mode.
Step 6	**archive upload-sw rcp:**[[[//[*username*@]*location*]/*directory*]/*image-name*.**tar**]	Uploads the currently running WMIC image to the RCP server. • For //*username*, specify the username; for the RCP copy request to execute, an account must be defined on the network server for the remote username. For more information, see the "Preparing to Download or Upload an Image File by Using RCP" section on page 7-27. • For @*location*, specify the IP address of the RCP server. • For /*directory*]/*image-name*.**tar**, specify the directory (optional) and the name of the software image to be uploaded. Directory and image names are case sensitive. • The *image-name*.**tar** is the name of software image to be stored on the server.

The **archive upload-sw** privileged EXEC command builds an image file on the server by uploading these files in order: info, the IOS image, the HTML files, and info.ver. After these files are uploaded, the upload algorithm creates the tar file format.

Cisco 3200 WMIC Image Upload Procedure

This section provides the procedures for configuring a Cisco 3200 Series router (referred to as the Mobile Access Router Card (MARC)) as a TFTP server and uploading a Cisco IOS image to the router and two WMICs enclosed with the router. The major advantage of this procedure is that all the cards in the router receive the same version of the Cisco IOS image to avoid conflicts when the devices communicate.

Overview

The Cisco 3200 Series router is actually a *stack* of devices contained in an enclosure that can include multiple devices that process data from the network independently. For example, a Cisco 3200 Series router with two WMICs is actually three devices in one enclosure; one router, consisting of a MARC and possibly a Fast Ethernet Switch Mobile Interface Card (FESMIC) and/or a Serial Mobile Interface Card (SMIC), and two WMICS.

The MARC communicates with a FESMIC or a SMIC through the internal PCI bus. The FESMIC and the SMIC depend on the MARC to process the data that the FESMIC or SMIC send and receive. As a result, FESMIC and SMIC cards are seen by the MARC as expansion cards, similar to the way in which a modular Cisco router increases functionality with the addition of expansion modules. The cards physically and logically become part of the router.

Each WMIC has an on-board CPU that processes data it sends and receives independent of the MARC. The WMICs draw power from the internal bus; they do not use the bus to communicate with the other devices in the stack. The WMICs communicate with the router by using the switched Fast Ethernet ports and the routed Fast Ethernet port to create a small, internal Ethernet network. As a result, each WMIC must store a copy of the Cisco IOS image in its memory and be configured independently.

To avoid conflicts, we recommend that you upload the same image to all of the devices (CPUs) in the enclosure by configuring the router as a TFTP server that can serve the Cisco IOS image to the WMICs.

The following major steps are required to upload the Cisco IOS image to all the devices in a Cisco 3200 Series router stack.

Step 1 Configure the router as shown in the "Configuration Example for the MARC" section and verify connectivity to a TFTP server.

Step 2 To copy the image to the MARC, use the **copy tftp flash:***tarfilename* command.

Step 3 Enter the **tftp-server flash:***tarfilename* command to configure the MARC as a TFTP server, making the image available to the WMICs.

Step 4 Configure router for IP connectivity to all of the WMICs. Examples are provided in the "Fast Ethernet 0/0 WMIC Configuration Example Configuration" section on page 7-33, the "Configuration Example for the WMIC Attached to Switch Port 4" section on page 7-34, and the "Configuration Example for the WMIC Attached to Switch Port 3" section on page 7-35.

Step 5 Upload the new image to the WMICs, for example:

- Enter the **archive download-software /overwrite tftp://20.20.20.1/c3202-k9w7-tar** command
- Enter the **archive download-software /overwrite tftp://10.10.10.1/c3202-k9w7-tar** command
- Enter the **archive download-software /overwrite tftp://10.10.10.2/c3202-k9w7-tar** command

Step 6 To verify that the new image is in place, use the **show version** command.

Configuration Example for the MARC

```
hostname MAR
!
ip routing
!
interface FastEthernet0/0
 ip address 20.20.20.1 255.255.255.0
!
interface FastEthernet2/0
no ip address
 shutdown
!
interface FastEthernet2/1
 no ip address
 shutdown
!
interface FastEthernet2/2
 no ip address
 no shutdown
!
interface FastEthernet2/3
 no ip address
 no shutdown
!
interface Vlan1
 ip address 10.10.10.1 255.255.255.0
no shutdown
!
tftp-server flash: c3202-k9w7-tar
!
end
```

Fast Ethernet 0/0 WMIC Configuration Example Configuration

```
hostname MAR1-AP
!
bridge irb
!
interface Dot11Radio0
 no ip address
 no ip route-cache
 no shutdown
 !
 ssid tsunami
    authentication open
    infrastructure-ssid
 !
 cca 0
 speed basic-1.0 basic-2.0 basic-5.5 6.0 9.0 basic-11.0 12.0 18.0 24.0 36.0 48.0 54.0
 rts threshold 4000
 station-role workgroup-bridge
 infrastructure-client
 bridge-group 1
 bridge-group 1 subscriber-loop-control
 bridge-group 1 block-unknown-source
 no bridge-group 1 source-learning
 no bridge-group 1 unicast-flooding
 bridge-group 1 spanning-disabled
!
```

```
interface FastEthernet0
 no ip address
 bridge-group 1
 no bridge-group 1 source-learning
 bridge-group 1 spanning-disabled
 no shutdown
!
interface BVI1
 ip address 20.20.20.2 255.255.255.0
 no ip route-cache
 no shutdown
!
ip default-gateway 20.20.20.1
!
bridge 1 route ip
!
end
```

Configuration Example for the WMIC Attached to Switch Port 4

```
hostname MAR1-SWITCHPORT4
!
bridge irb
!
interface Dot11Radio0
 no ip address
 no ip route-cache
 no shutdown
  !
cca 0
 speed basic-1.0 basic-2.0 basic-5.5 6.0 9.0 basic-11.0 12.0 18.0 24.0 36.0 48.0 54.0
 rts threshold 4000
 station-role root ap-only
 infrastructure-client
 bridge-group 1
 bridge-group 1 subscriber-loop-control
 bridge-group 1 block-unknown-source
 no bridge-group 1 source-learning
 no bridge-group 1 unicast-flooding
 bridge-group 1 spanning-disabled
!
interface FastEthernet0
 no ip address
 bridge-group 1
 no bridge-group 1 source-learning
 bridge-group 1 spanning-disabled
 no shutdown
!
interface BVI1
 ip address 10.10.10.2 255.255.255.0
 no ip route-cache
!
ip default-gateway 10.10.10.1
bridge 1 route ip
!
end
```

Configuration Example for the WMIC Attached to Switch Port 3

```
hostname MAR1-SWITCHPORT3
!
bridge irb
!
interface Dot11Radio0
 no ip address
 no ip route-cache
 no shutdown
 !
 cca 0
 speed basic-1.0 basic-2.0 basic-5.5 6.0 9.0 basic-11.0 12.0 18.0 24.0 36.0 48.0 54.0
 rts threshold 4000
 station-role root ap-only
 infrastructure-client
 bridge-group 1
 bridge-group 1 subscriber-loop-control
 bridge-group 1 block-unknown-source
 no bridge-group 1 source-learning
 no bridge-group 1 unicast-flooding
 bridge-group 1 spanning-disabled
!
interface FastEthernet0
 no ip address
 bridge-group 1
 no bridge-group 1 source-learning
 bridge-group 1 spanning-disabled
 no shutdown
!
interface BVI1
 ip address 10.10.10.3 255.255.255.0
 no ip route-cache
!
ip default-gateway 10.10.10.1
bridge 1 route ip
!
end
```

APPENDIX A

Smart Serial Port External Seal

The Smart Serial port is not sealed. When the Smart Serial port is not connected or otherwise in use, the protective cover that is provided should be used to seal the port. When a Smart Serial port is connected by means of a cable, protective heat-shrink tubing should be used to seal the port. We recommend 4:1 shrink-ratio tubing (one piece is provided).

To seal the Smart Serial ports, complete the following steps:

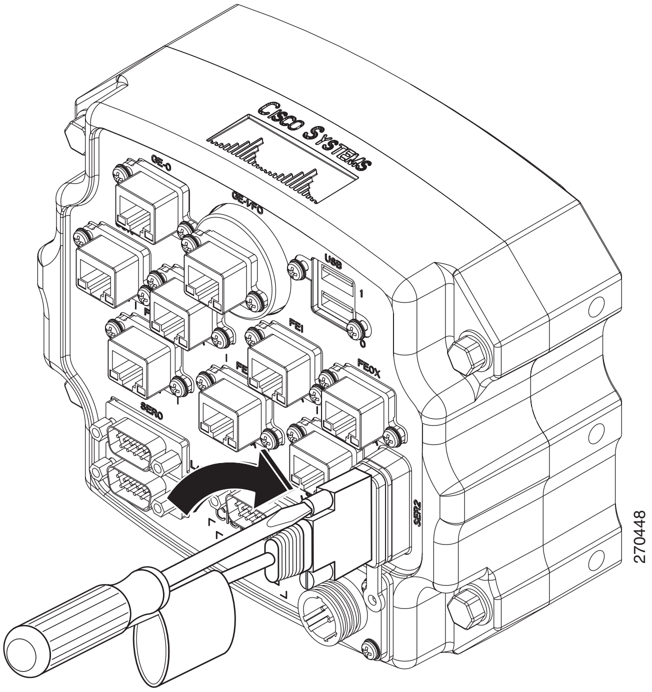
Step 1 Cut a 1.8-inch length of heat-shrink tubing.

Step 2 If the Smart Serial port cable is attached, remove it.

Step 3 Feed the cable through the heat-shrink tubing.

Step 4 Secure the cable back onto the Smart Serial port by using the jack screws of the cable assembly, as shown in Figure A-1.

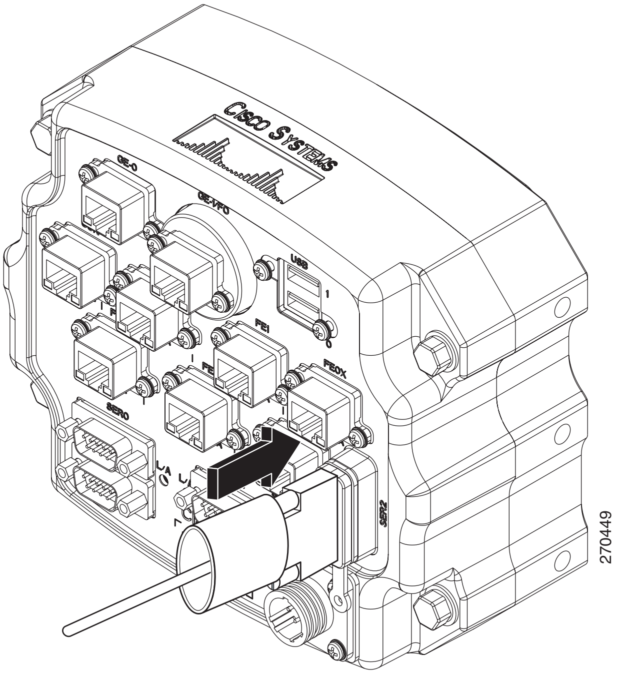
Figure A-1 Securing the Smart Serial Port Cable



Step 5 Move and secure adjacent port protectors away from the smart serial port.

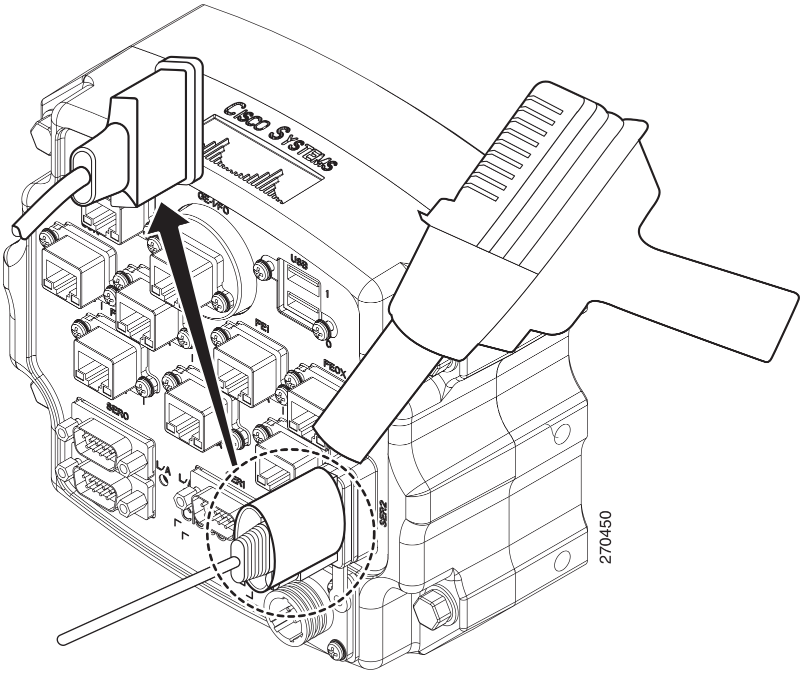
Step 6 Position the heat-shrink tubing as shown in Figure A-2, so that one end is over the cable molding, over the chassis protrusion, and abuts the end cap.

Figure A-2 Positioning the Heat-Shrink Tubing Over the Cable Molding



Step 7 Apply heat by using a heat gun. Heat the tubing until it is reduced in size and fits snugly over the chassis protrusion of the smart serial port. Once it is secure, direct the heat toward the other end of the tubing to shrink it against the cable molding, as shown in Figure A-3.

Figure A-3 Applying Heat to the Heat-Shrink Tubing



APPENDIX B

SFP Module Replacement

This chapter describes how to replace small-form-factor pluggable (SFP) modules. SFP modules are inserted into the SFP module slot on the Cisco 3270 Rugged Router card. These modules provide the uplink optical interfaces, laser send (TX) and laser receive (RX).

The following are qualified Gigabit SFP modules:

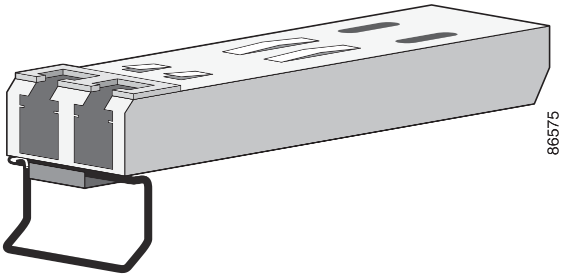
- Gigabit Multi-Mode SFP (Cisco part number: GLC-SX-MM-RGD):
- Gigabit Single-Mode SFP (Cisco part number: GLC-LX-SM-RGD):

Each SFP must be of the same type as the SFP on the other end of the cable, and the cable must not exceed the stipulated cable length for reliable communications. Figure B-1 shows an SFP module that has a bale-clasp latch.

Caution We strongly recommend that you not install or remove the SFP module while the fiber-optic cable is attached to it because of the potential damage to the cables, to the cable connector, or to the optical interfaces in the SFP module. Disconnect the cable before you remove or install an SFP module.

Removing and installing an SFP module can shorten its useful life. Do not remove and insert SFP modules more often than is necessary.

Figure B-1 SFP Module with a Bale-Clasp Latch



Caution To avoid damaging the cables, follow standard fiber optic cleaning procedures when connecting fiber optic cables to fiber-optic ports.

Replacing SFP Modules into SFP Module Slots

This section describes how to replace an SFP module.

Warning **Class 1 laser product.** Statement 1008

To insert an SFP module into the SFP module slot, follow these steps:

Step 1 Attach an ESD-preventive wrist strap to your wrist and to a bare metal surface on the chassis.

Step 2 Remove the antenna end cap by using a 3/8-in. wrench to loosen the bolts.

Step 3 Disconnect the LC from the SFP module.

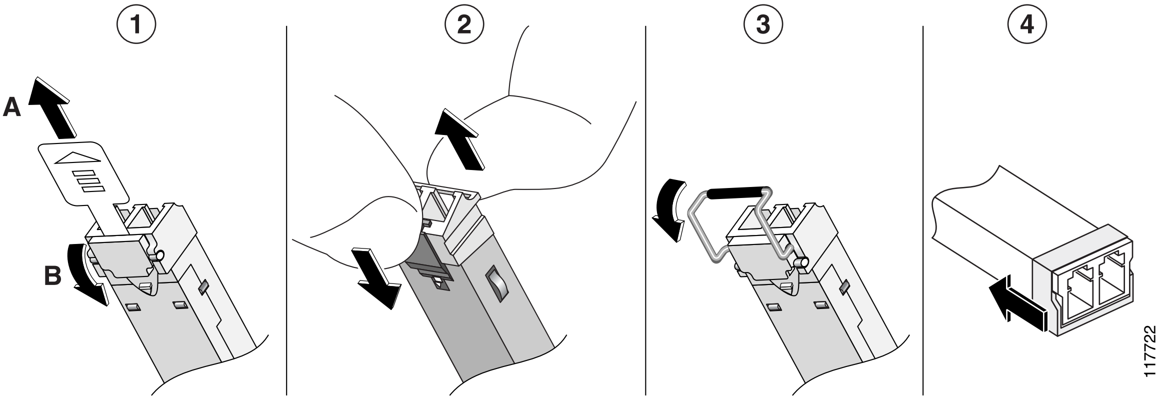
Tip For reattachment, note which cable connector plug is send (TX) and which is receive (RX).

Step 4 Insert a dust plug into the optical ports of the SFP module to keep the optical interfaces clean.

Caution Do not touch the optical surfaces.

Step 5 Unlock and remove the SFP module.

Figure B-2 Disconnecting SFP Latch Mechanisms



Step 6 Pull the bale-clasp latch out and down to eject the module. If the bale-clasp latch is obstructed and you cannot use your index finger to open it, use a small, flat-blade screwdriver or other long, narrow instrument to open the bale-clasp latch.

Step 7 Grasp the SFP module between your thumb and index finger, and carefully remove it from the module slot.

Step 8 Place the removed SFP module in an antistatic bag or other protective environment.

Caution Do not remove the rubber plugs from the SFP module port or the rubber caps from the fiber-optic cable until you are ready to connect the cable. The plugs and caps protect the SFP module ports and cables from contamination and ambient light.

Step 9 Find the send (TX) and receive (RX) markings that identify the top side of the replacement SFP module.

Note On some SFP modules, the send and receive (TX and RX) markings might be replaced by arrows that show the direction of the connection, either send or receive (TX or RX).

Step 10 Align the SFP module in front of the slot opening.

Step 11 Insert the SFP module into the slot until you feel the connector on the module snap into place in the back of the slot.

Step 12 Remove the dust plugs from the SFP module optical ports. Store the plugs for later use.

Caution Do not remove the dust plugs from the SFP module port or the rubber caps from the fiber-optic cable until you are ready to connect the cable. The plugs and caps protect the SFP module ports and cables from contamination and ambient light.

Step 13 Clean the fiber-optic connectors by using standard procedures.

Step 14 Insert the LC cable connector into the SFP module.

Step 15 Verify that the gasket is in place and replace the Antenna end cap by using a 3/8-in. wrench to remove the bolts, torquing the bolts to 58 to 68 inch-pounds.

Diagnosing SFP Problems

You can get statistics from the browser interface, from the CLI, or from an SNMP workstation.

Common SFP module problems fall into these categories:

- Poor performance
- No connectivity
- Corrupted software

Table B-1 describes how to detect and resolve these problems.

Table B-1 Common SFP Problems

Symptom	Possible Cause	Resolution
Poor performance or excessive errors	Cabling distance exceeded. Port statistics show excessive frame check sequence (FCS), late-collision, or alignment errors.	Reduce the cable length to within the recommended distances. See your SFP module documentation for cabling guidelines.
No connectivity	Incorrect or bad cable The cable is wired incorrectly. STP checking for possible loops.	Verify the pinouts are correct for the proper application of cables. Replace the cable with a tested good cable. Wait 30 seconds for the port LED to turn green.

Table B-1 Common SFP Problems (continued)

Symptom	Possible Cause	Resolution
The port is placed in error-disabled state after SFP module is inserted	Bad or non-Cisco-approved SFP module.	Remove the SFP module and replace it with a Cisco-approved module. Use the **errdisable recovery cause gbic-invalid** global configuration command to verify the port status, and enter a time interval to recover from the error-disable state.
The port is placed in error-disabled state after SFP is inserted	Bad or non-Cisco-approved SFP module.	Remove the SFP module from the switch and replace it with a Cisco-approved module. Use the **errdisable recovery cause gbic-invalid** global configuration command to verify the port status, and enter a time interval to recover from the error-disable state.
Device does not recognize the SFP module	The SFP module might be installed upside down. The SFP module did not snap into the slot.	Verify that the SFP module is not installed upside down. Remove the SFP module. Inspect for physical damage to the connector, the module, and the module slot. Replace the SFP module with a known good SFP module.
Excessive errors found in port statistics	Bad adapter in attached device or STP checking for possible loops.	Run adapter card diagnostic utility and wait 30 seconds for the port LED to turn green.

Error Messages

Error Message `Transceiver module inserted in` *`port`*

Explanation The online insertion and removal (OIR) facility detected a newly inserted transceiver module for the interface specified in the error message.

Error Message `INIT_FAILURE: Detected for transceiver module in port, module disabled`

Explanation An initialization failure occurred for the transceiver module for the interface specified in the error message. This condition could be caused by software, firmware, or hardware problem. As a result of the error, the module is disabled.

Recommended Action Try reseating the module. Hardware replacement should not occur first occurrence. Before requesting hardware replacement, review troubleshooting logs with a technical support representative.

Error Message `NOT_IDENTIFIED: Detected for transceiver module in %s, module disabled`

Explanation The transceiver module for the interface specified in the error message could not be identified and may not be compatible with the interface. The transceiver module specified in the error message contains a transceiver code which could not be correctly interpreted. As a result of the error, the module is disabled.

Recommended Action Replace the module with a compatible transceiver.

Error Message `UNSUPPORTED-TRANCEIVER: Unsupported SFP transceiver found on board. Warranty/support may void`

Explanation The transceiver module for the interface specified in the error message is not a Cisco supported module. As a result of the error, the module is disabled. When Cisco determines that a fault or defect can be traced to the use of third-party transceivers installed by a customer or reseller, then, at Cisco's discretion, Cisco may withhold support under warranty or a Cisco support program. In the course of providing support for a Cisco networking product Cisco might require that the end user install Cisco transceivers if Cisco determines that removing third-party parts will assist Cisco in diagnosing the cause of a support issue.

Recommended Action None.

APPENDIX C

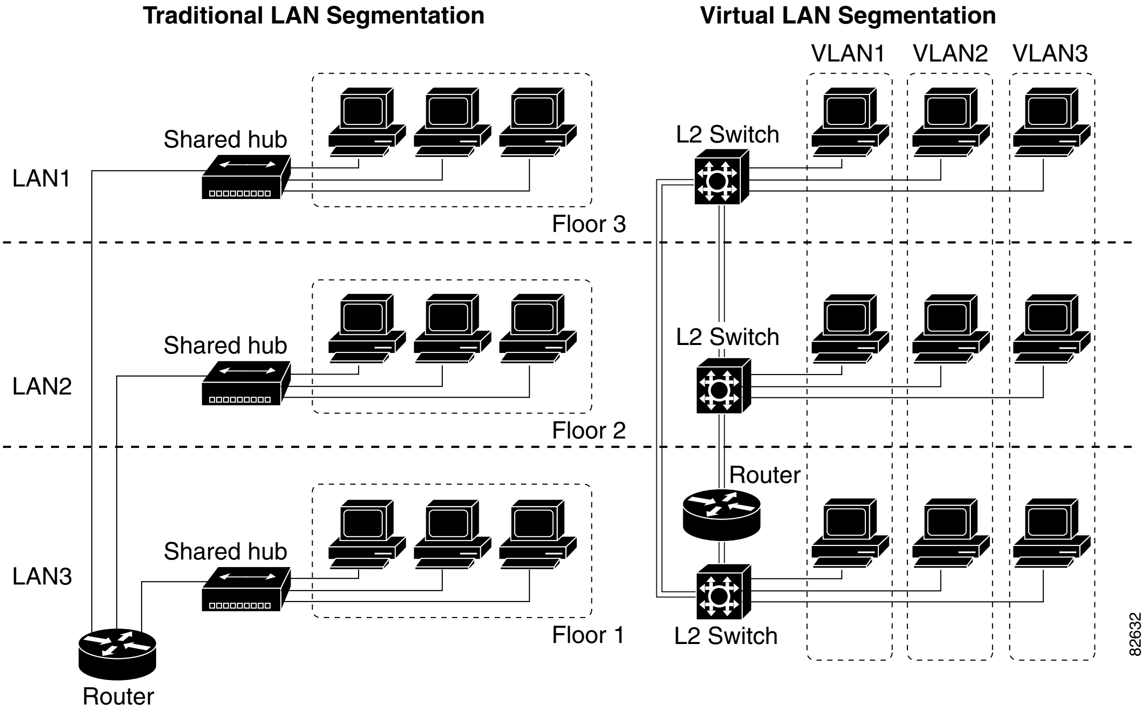
Switch Port Functionality

The 10/100 Fast Ethernet ports on the Cisco 3200 Series router FESMIC default to Layer 2 switch ports. The FESMIC is a “learning bridge,” as defined in 802.1D with the Virtual Local Area Network (VLAN) capabilities of 802.1P/Q. The BCM5618 is fully capable of line-rate switching for all four 10/100 Fast Ethernet ports.

VLANs provide the segmentation services traditionally provided by routers in LAN configurations, as shown in Figure C-1. VLANs make it easy to move an network or to change a network design.

- Broadcast control—Just as switches physically isolate collision domains for attached hosts and only forward traffic out a particular port, VLANs provide logical collision domains that confine broadcast and multicast traffic to the bridging domain.VLANs solve the scalability problems of large flat networks by breaking a single broadcast domain into several smaller broadcast domains.
- Security—VLANs improve security by isolating groups. High-security users can be grouped into a VLAN, possibly on the same physical segment. If you do not include a router in a VLAN, no one outside that VLAN can communicate with the users inside the VLAN and vice versa. This extreme level of security can be highly desirable. Users outside that VLAN cannot penetrate into the VLAN without an appropriate routing through secure Layer 3 routing services.
- Performance—Users that require high-performance networking can be assigned to their own VLAN. You might, for example, assign an engineer who is testing a multicast application and the servers that the engineer is using to a single VLAN. The engineer experiences improved network performance by being on a “dedicated LAN.” The rest of the engineering group experiences improved network performance, because the traffic generated by the network-intensive application is isolated to another VLAN. This of course implies some areas of physical isolation of separate VLANs or prioritized service by tagging support and prioritized queuing classes within the switches and bridges of the 802.1Q VLAN.
- Network management—Software on the switch allows you to assign users to VLANs. Changing the cabling to change connectivity is no longer necessary in the switched LAN environment because network management tools allow you to reconfigure the LAN logically in seconds.

Figure C-1 Traditional LAN Segmentation versus VLAN Segmentation



Port-Based VLAN

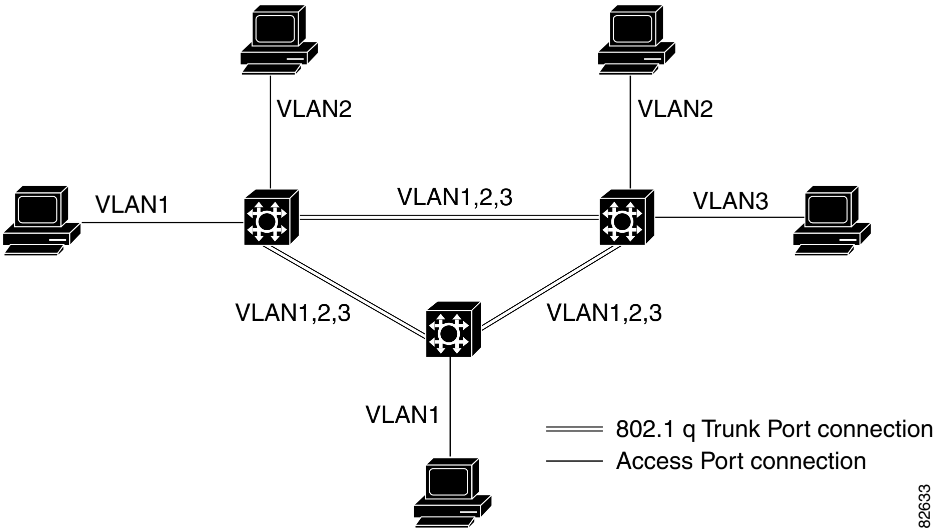
By default, the 10/100 Fast Ethernet interfaces on the FESMIC are defaulted to Layer 2 switch ports and all four interfaces belong to VLAN 1. You can partition the switch ports to belong to different VLAN groups by using the **switchport vlan access** <*vlan-id*> command. The following is a brief function description of a FESMIC port-based VLAN:

- Each VLAN has its own MAC address table.
- Packets received are forwarded only to ports that are members of the same VLAN as the receiving port. VLAN partitions provide hard firewalls for all traffic in different VLANs.
- A VLAN comes into existence when a user adds a VLAN to the local VLAN database. A maximum of 32 VLANs are supported. VLAN IDs can range from 1 to 1005.
- By default, a spanning tree instance is created for each VLAN.

802.1Q Trunking

A trunk is a point-to-point link between one or more Ethernet switch ports and another networking device, such as a router or a switch. Trunks carry the traffic of multiple VLANs over a single link, and they allow you to extend VLANs across an entire network, as shown in Figure C-2. The IEEE 802.1q protocol is an industry-standard trunking encapsulation.

Figure C-2 802.1Q Trunk Port Application

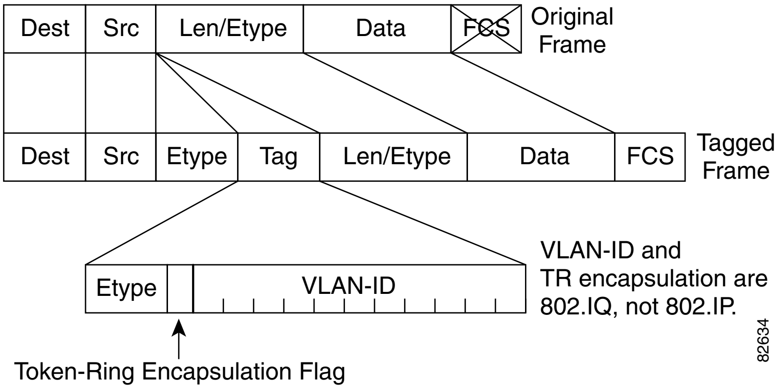


The 802.1Q trunk port is used for VLAN extension from one switch to another 802.1Q-capable switch, and used for an 802.1Q-capable router for inter-VLAN routing. The FESMIC supports both the VLAN extension and inter-VLAN routing.

The 802.1Q uses an internal tagging mechanism. Internal tagging means that a tag is inserted within the frame. Note that on an 802.1Q trunk, one VLAN is *not* tagged. This VLAN, named the *native VLAN*, must be configured the same on each side of the trunk. We can deduce to which VLAN a frame belongs when we receive a frame with no tag. The EtherType field identifying the 802.1Q frame is 0x8100. In addition to the 12-bit VLAN-ID, 3 bits are reserved for 802.1P priority tagging, as shown in Figure C-3. Also, note that inserting a tag into a frame that already has the maximum Ethernet size creates a 1522 byte frame, that can be considered a “baby giant” by the receiving equipment.

The FESMIC is capable of 802.1Q tagging, only supporting 802.1Q trunking encapsulation. It does not support the Cisco proprietary ISL encapsulation.

Figure C-3 802.1Q Tag Format in an Ethernet Frame

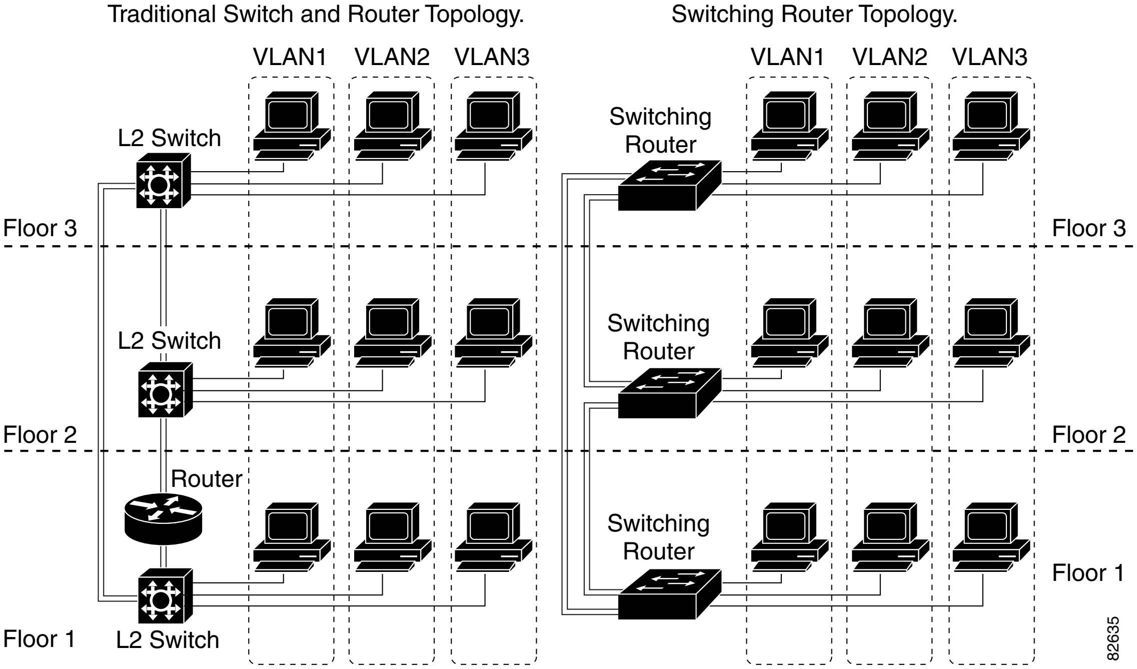


Inter-VLAN Routing

In a VLAN network, traffic and stations for multiple network layer subnets (VLANs) can coexist on a single physical LAN segment. In practice, a single VLAN corresponds to a network subnet, and a VLAN trunking capable router is required to forward traffic from a first VLAN to a second VLAN for a Layer 2 switch.

The FESMIC enables the Cisco 3200 Series router to become one of first IOS Ethernet switching routers to deliver intelligent Layer 2 switching capability and Layer 3 inter-VLAN routing in a single box solution, as shown in Figure C-4

Figure C-4 Switching Router Network Topology



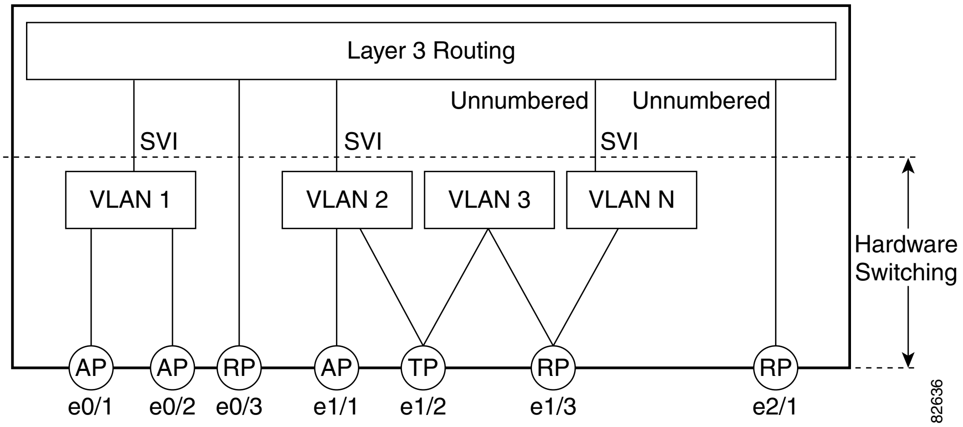
In a typical IOS-managed Layer 2 switch, there would be one Layer 3 Switch Virtual Interface (SVI) that allows you to configure the device over a Layer 3 protocol by using SNMP or a Telnet application. This is referred to as the *management VLAN* for the switch. The default management VLAN is usually the native VLAN 1. The configurable VLAN device allows you to configure any VLAN to be the management VLAN, but there can be only one virtual Layer 3 interface in one VLAN.

A switch routing module, like the FESMIC, allows you to use the SVI to configure more than one virtual Layer 3 interface to support routing between the different VLANs, and the virtual Layer 3 interface of any other router interface in the system, as shown in Figure C-5.

You can manage the switching router with any switch virtual Layer 3 interface created in the system. The FESMIC router switch port is an interface capable of handling Layer 3 switching functionality in hardware. The SVI architecture has the framework to support such a functionality.

- A SVI represents a VLAN of switch ports as one interface to the routing function in the system.
- There is at most one SVI associated with a VLAN.
- It is not necessary to configure an SVI for every known VLAN. It is only necessary to configure a SVI when you want to route between VLANs or want to provide IP host connectivity to the rest of the network by using any of the mobile access router routed interfaces.
- One management SVI, interface VLAN 1, is created at system initialization to permit remote administration. Additional SVIs exist only when explicitly configured by a user.

Figure C-5 Switch Virtual Interface Architecture



VLAN Trunk Protocol (VTP)

VLAN Trunk Protocol (VTP) is a Layer 2 messaging protocol that maintains VLAN configuration consistency by managing the addition, deletion, and renaming of VLANs within a VTP domain. A VTP domain (also called a *VLAN management domain*) is made up of one or more switches that share the same VTP domain name and that are interconnected with trunks. VTP minimizes configuration errors and configuration inconsistencies that can result in a number of problems, such as duplicate VLAN names, incorrect VLAN-type specifications, and security violations.

The FESMIC supports both VTP version 1 and version 2.

- VTP server mode—You can create, modify, or delete VLANs and specify other configuration parameters (such as VTP version and VTP pruning) for the entire VTP domain. VTP servers advertise their VLAN configuration to other switches in the same VTP domain and synchronize their VLAN configuration with other switches, based on advertisements received over trunk links. VTP server is the default mode.
- VTP clients mode— Behaves the same way as VTP servers, but you cannot create, change, or delete VLANs on a VTP client.
- VTP transparent mode—Switches do not participate in VTP. A VTP-transparent switch does not advertise its VLAN configuration and does not synchronize its VLAN configuration based on received advertisements. However, in VTP version 2, transparent switches do forward VTP advertisements that they receive out their trunk interfaces.

VTP Server Example

The following example shows how to configure the switch as a VTP server:

```
Router# vlan database
Router(vlan)# vtp server
Setting device to VTP SERVER mode.
Router(vlan)# vtp domain Lab_Network
Setting VTP domain name to Lab_Network
Router(vlan)# vtp password WATER
Setting device VLAN database password to WATER.
Router(vlan)# exit
APPLY completed.
Exiting....
Router#
```

VTP Client Example

The following example shows how to configure the switch as a VTP client:

```
Router# vlan database
Router(vlan)# vtp client
Setting device to VTP CLIENT mode.
Router(vlan)# exit

In CLIENT state, no apply attempted.
Exiting....
Router#
```

Disabling VTP (VTP Transparent Mode) Example

The following example shows how to configure the switch as VTP transparent:

```
Router# vlan database
Router(vlan)# vtp transparent
Setting device to VTP TRANSPARENT mode.
Router(vlan)# exit
APPLY completed.
Exiting....
Router#
```

VTP Version 2 Example

The following example shows how to enable VTP version 2:

```
Router# vlan database
Router(vlan)# vtp v2-mode

V2 mode enabled.
Router(vlan)# exit

APPLY completed.
Exiting....
Router#
```

802.1P CoS

The IEEE 802.1P specification defines eight levels of priority (0 thru 7), with priority 7 being the highest priority. This information is carried in the 3-bit priority field of the VLAN tag header.

The FESMIC supports up to four class of service (CoS) queues per port. For the tagged packets, the incoming packet priority can be mapped into one of the four queues, based on the priority field in the tag header or from the result of filtering mechanism. For untagged packets, the CoS priority is derived either from a programmable field within the ARL (MAC address table) or from the result of filtering mechanism.

After the packets are mapped into a CoS queue, they are forwarded or conditioned using these scheduling algorithms:

- Strict priority-based scheduling—Any packets residing in the higher priority queues are transmitted first. Only when these queues are empty will packets of lower priority be transmitted. The disadvantage of this scheme is the potential starvation of packets in lower priority queues.
- Weighted round-robin scheduling—This scheme alleviates the starvation of packets in lower priority queues by providing a certain minimum bandwidth to all queues for transmission. This bandwidth is programmable as the maximum number of packets of each CoS.

The FESMIC 10/100 Fast Ethernet interfaces default to use the strict priority-based scheduling. After system boots, you can enable weighted round-robin scheduling.

Mapping 802.1P priority to IP precedence bits is not supported.

Spanning Tree Protocol (STP)

Spanning Tree Protocol (STP) is a link management protocol that provides path redundancy while preventing undesirable loops in the network. For an Ethernet network to function properly, only one active path can exist between any two stations. When two ports on a switch are in a loop, the spanning tree port priority and port path cost setting determine which port to put in the forwarding state and which port to put in the blocking state.

The 802.1Q standard defines the method for running multiple VLANs over single or multiple physical LAN segments and defines a unique spanning tree instance to be created on each of the VLAN instances for all the VLANs in a network.

A mono spanning tree (MST) network lacks some flexibility, compared to a per VLAN spanning tree (PVST) network, which runs one instance of STP per VLAN. One spanning tree is created for every new VLAN created on a FESMIC interface. STP is enabled by default on VLAN 1 and on all newly created VLANs.

Cisco developed PVST+ to allow running several STP instances (even over an 802.1Q network) by using a tunneling mechanism. Although beyond the scope of this document, PVST+ can be briefly described as utilizing a Cisco device to connect a MST zone (typically another vendor’s 802.1Q-based network) to a PVST zone (typically a Cisco 802.1Q-based network). There is no specific configuration to enter in order to achieve this. PVST+ is a spanning tree that allows the coexistence of both PVST and Shared Spanning Tree Protocol (SSTP) in a mixed vendor environment.

The STP described in IEEE 802.1D standard takes a substantial amount of time to converge to a loop free topology. It fails to take advantage of the point-to-point wiring found in modern networks. PVST is enabled on all switch platforms. Rapid Spanning Tree Protocol (RSTP), specified in IEEE 802.1w[9], improves the operation of STP, while maintaining compatibility with equipment based on the (original) 802.1d Spanning Tree standard.

Note The Cisco Shared Spanning Tree Architecture documents use the terms MST and SST to mean “Mono Spanning Tree” and “Shared Spanning Tree” respectively. The IEEE 802.1s[10] uses the same terms but with exactly opposite meanings, i.e. MST is “Multiple Spanning Trees” and SST is” Single Spanning Tree.”

When you connect two Cisco switches through 802.1Q trunks, the switches exchange spanning-tree bridge packet data units (BPDUs) on each VLAN allowed on the trunks. The BPDUs on the native VLAN of the trunk are sent untagged to the reserved IEEE 802.1d spanning-tree multicast MAC address (01-80-C2-00-00-00). The BPDUs on all other VLANs on the trunk are sent tagged to the reserved Shared Spanning Tree Protocol (SSTP).

One spanning tree is created for every new VLAN that is created on the FESMIC. STP is enabled by default on VLAN 1 and on all the newly created VLANs.

PVST and PVST+ are enabled by default on the FESMIC.

For detailed information on how STP works, go to http://www.cisco.com.

Switch Virtual Interface

A Switch Virtual Interface (SVI) represents a VLAN of switch ports as one interface to the routing or bridging function in the system. Only one SVI can be associated with a VLAN, but it is necessary to configure an SVI for a VLAN only when you wish to route between VLANs, fallback-bridge nonroutable protocols between VLANs, or to provide IP host connectivity to the switch. By default, an SVI is created for the default VLAN (VLAN 1) to permit remote switch administration. Additional SVIs must be explicitly configured. In Layer 2 mode, SVIs provide IP host connectivity only to the system; in Layer 3 mode, you can configure routing across SVIs.

SVIs are created the first time that you enter the **vlan** interface configuration command on a VLAN interface. The VLAN corresponds to the VLAN tag associated with data frames on an ISL or 802.1Q encapsulated trunk or the VLAN ID configured for an access port. Configure a VLAN interface for each VLAN for which you want to route traffic, and assign it an IP address.

SVIs support routing protocol and bridging configurations.

Creating a SVI

To make any of the 2-port FESMIC or the 4-port FESMIC switchports routable, do the following:

Step 1 Create a VLAN ID that will be used for the VLAN.

Step 2 From the enable prompt, (not the global configuration prompt) enter the following commands:

```
Router#vlan database
! your prompt is now "Router(vlan)#"
Router(vlan)#vlan 7
Router(vlan)#exit
```

Note If you skip Step 2, your switchport virtual interface line protocol will be down.

Step 3 Go to global configuration mode and enter your switchport.

```
Router>conf t
Router#interface FastEthernet3/0
Router(config-if)#switchport access vlan 7
```

Step 4 Configure the IP address for the interface by entering the SVI

```
Router(config-if)#interface configuration:
Router(config-if)#interface vlan 7
Router(config-if)#ip address 7.7.7.7 255.255.255.0
```

The 10/100 Fast Ethernet 3/0 switchport can be pinged by through the VLAN interface. You can now attach any Layer 3 features to interface with the VLAN.

IP Multicast Layer 3 Switching

This section describes how to configure IP multicast Layer 3 switching.

You must enable IP multicast routing globally before you can enable IP multicast Layer 3 switching on Layer 3 interfaces.

For complete information and procedures, refer to these publications:

- *Cisco IOS IP Configuration Guide*, Release 12.2, at this URL:

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fipr_c/
- Cisco IOS IP Command Reference, Volume 1 of 3: Addressing and Services, Release 12.2 at this URL:

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fipras_r/index.htm
- Cisco IOS IP Command Reference, Volume 2 of 3: Routing Protocols, Release 12.2 at this URL:

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fiprrp_r/index.htm
- Cisco IOS IP Command Reference, Volume 3 of 3: Routing Protocols, Release 12.2 at this URL:

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fiprmc_r/index.htm

To enable IP multicast routing globally, Use this command in global configuration mode:

Command	Purpose
`Router(config)#` **`ip multicast-routing`**	Enables IP multicast routing globally.

Enabling IP PIM on Layer 3 Interfaces

You must enable PIM on the Layer 3 interfaces before IP multicast Layer 3 switching functions on those interfaces.

To enable IP PIM on a Layer 3 interface, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)#` **`interface vlan`** *`vlan_id`* `{slot/port}`	Selects the interface to be configured.
Step 2	`Router(config-if)#` **`ip pim`** `{`**`dense-mode`** `|` **`sparse-mode`** `|` **`sparse-dense-mode`**`}`	Enables IP PIM on a Layer 3 interface.

This example shows how to enable PIM on an interface using the default mode (**sparse-dense-mode**):

```
Router(config-if)# ip pim
Router(config-if)#
```

This example shows how to enable PIM sparse mode on an interface:

```
Router(config-if)# ip pim sparse-mode
Router(config-if)#
```

Verifying IP Multicast Layer 3 Hardware Switching Summary

The **show ip pim interface count** command verifies the IP multicast Layer 3 switching enable state on IP PIM interfaces and the number of packets received and sent on the interface.

Note The **show interface statistics** command does not verify hardware-switched packets, only packets switched by software.

Use the following show commands to verify IP multicast Layer 3 switching information for an IP PIM Layer 3 interface, as illustrated below:

Step 1 Enter the `show ip pim interface count` command.

```
Router# show ip pim interface count

State:* - Fast Switched, D - Distributed Fast Switched
      H - Hardware Switching Enabled
Address          Interface          FS  Mpackets In/Out
10.15.1.20       GigabitEthernet4/8 * H 952/4237130770
10.20.1.7        GigabitEthernet4/9 * H 1385673757/34
10.25.1.7        GigabitEthernet4/10* H 0/34
10.11.1.30       FastEthernet6/26   * H 0/0
10.37.1.1        FastEthernet6/37   * H 0/0
1.22.33.44       FastEthernet6/47   * H 514/68
```

Step 2 Enter the `show ip mroute count` command.

```
Router# show ip mroute count
IP Multicast Statistics
56 routes using 28552 bytes of memory
13 groups, 3.30 average sources per group
Forwarding Counts:Pkt Count/Pkts per second/Avg Pkt Size/Kilobits per second
Other counts:Total/RPF failed/Other drops(OIF-null, rate-limit etc)

Group:224.2.136.89, Source count:1, Group pkt count:29051
  Source:132.206.72.28/32, Forwarding:29051/-278/1186/0, Other:85724/8/56665
Router#
```

Note The -tive counter means that the outgoing interface list of the corresponding entry is NULL, and this indicates that this flow is still active.

Step 3 Enter the `show ip interface vlan 10` command.

```
Router# show ip interface vlan 10
Vlan10 is up, line protocol is up
  Internet address is 10.0.0.6/8
  Broadcast address is 255.255.255.255
  Address determined by non-volatile memory
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is disabled
  Multicast reserved groups joined: 224.0.0.1 224.0.0.2 224.0.0.13 224.0.0.10
  Outgoing access list is not set
  Inbound  access list is not set
  Proxy ARP is enabled
  Security level is default
  Split horizon is enabled
  ICMP redirects are always sent
  ICMP unreachables are never sent
  ICMP mask replies are never sent
  IP fast switching is enabled
  IP fast switching on the same interface is disabled
  IP Flow switching is disabled
  IP CEF switching is enabled
  IP Fast switching turbo vector
  IP Normal CEF switching turbo vector
  IP multicast fast switching is enabled
  IP multicast distributed fast switching is disabled
  IP route-cache flags are Fast, CEF
  Router Discovery is disabled
  IP output packet accounting is disabled
  IP access violation accounting is disabled
  TCP/IP header compression is disabled
  RTP/IP header compression is disabled
  Probe proxy name replies are disabled
  Policy routing is disabled
  Network address translation is disabled
  WCCP Redirect outbound is disabled
  WCCP Redirect exclude is disabled
  BGP Policy Mapping is disabled
IP multicast multilayer switching is enabled
IP mls switching is enabled
Router#
```

Verifying the IP Multicast Routing Table

Use the **show ip mroute** command to verify the IP multicast routing table.

Step 1 Enter the **show ip mroute** command.

```
Router# show ip mroute 230.13.13.1

IP Multicast Routing Table
Flags:D - Dense, S - Sparse, s - SSM Group, C - Connected, L - Local,
       P - Pruned, R - RP-bit set, F - Register flag, T - SPT-bit set,
       J - Join SPT, M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP, U - URD, I - Received Source Specific Host
           Report
Outgoing interface flags:H - Hardware switched
Timers:Uptime/Expires
Interface state:Interface, Next-Hop or VCD, State/Mode

(*, 230.13.13.1), 00:16:41/00:00:00, RP 10.15.1.20, flags:SJC
  Incoming interface:GigabitEthernet4/8, RPF nbr 10.15.1.20
  Outgoing interface list:
 GigabitEthernet4/9, Forward/Sparse-Dense, 00:16:41/00:00:00, H

(*, 230.13.13.2), 00:16:41/00:00:00, RP 10.15.1.20, flags:SJC
 Incoming interface:GigabitEthernet4/8, RPF nbr 10.15.1.20, RPF-MFD
  Outgoing interface list:
    GigabitEthernet4/9, Forward/Sparse-Dense, 00:16:41/00:00:00, H

(10.20.1.15, 230.13.13.1), 00:14:31/00:01:40, flags:CJT
 Incoming interface:GigabitEthernet4/8, RPF nbr 10.15.1.20, RPF-MFD
  Outgoing interface list:
    GigabitEthernet4/9, Forward/Sparse-Dense, 00:14:31/00:00:00, H
```

```
(132.206.72.28, 224.2.136.89), 00:14:31/00:01:40, flags:CJT
  Incoming interface:GigabitEthernet4/8, RPF nbr 10.15.1.20, RPF-MFD
 Outgoing interface list:Null
Router#
```

Note The RPF-MFD flag indicates that the flow is completely hardware switched. The H flag indicates that the flow is hardware-switched on the outgoing interface.

Storm Control

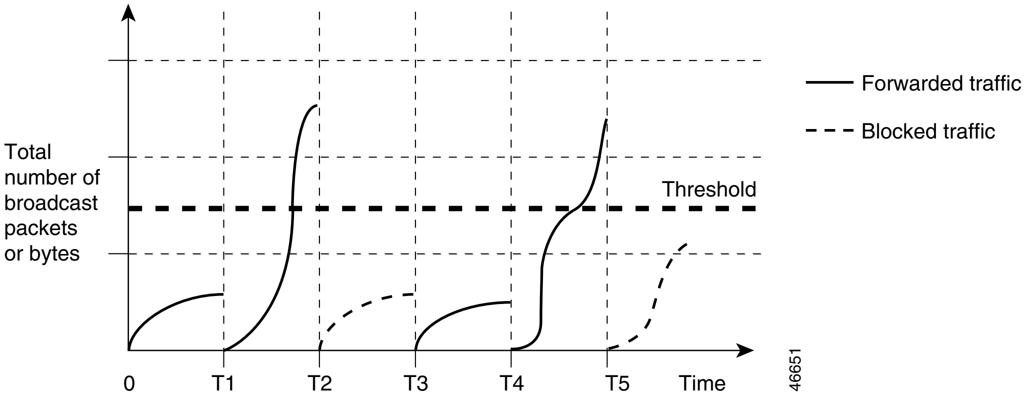
A packet storm occurs when a large number of broadcast, unicast, or multicast packets are received on a port. Forwarding these packets can cause the network to slow down or to time out. Storm control is configured for the switch as a whole, although it operates on a per-interface basis. By default, storm control is disabled.

Storm control prevents switch ports on a LAN from being disrupted by a broadcast, multicast, or unicast storm on one of the interfaces. A LAN storm occurs when packets flood the LAN, creating excessive traffic and degrading network performance. Errors in the protocol-stack implementation or in the network configuration can cause a storm.

Storm control monitors incoming traffic statistics over a time period and compares the measurement with a predefined suppression level threshold. The threshold represents the percentage of the total available bandwidth of the port. If the threshold of a traffic type is reached, further traffic of that type is suppressed until the incoming traffic falls below the threshold level.

The graph in Figure C-6 shows broadcast traffic patterns on an interface over a given period of time. In this example, the broadcast traffic exceeded the configured threshold between time intervals T1 and T2 and between intervals T4 and T5. When the amount of specified traffic exceeds the threshold, all traffic of that kind is dropped. Therefore, broadcast traffic is blocked during those intervals. At the next time interval, if broadcast traffic does not exceed the threshold, it is again forwarded.

Figure C-6 Broadcast Suppression Example



When storm control is enabled, the switch monitors the packets that are passing from an interface to the switching bus and determines whether the packet is unicast, multicast, or broadcast. The switch monitors the number of broadcast, multicast, or unicast packets received within the 1-second time interval, and when a threshold for one type of traffic is reached, that type of traffic is dropped. This threshold is specified as a percentage of the total available bandwidth that can be used by broadcast (multicast or unicast) traffic.

The combination of broadcast suppression threshold numbers and the 1-second time interval control the way the suppression algorithm works. A higher threshold allows more packets to pass through. A threshold value of 100 percent means that no limit is placed on the traffic.

Note Because packets do not arrive at uniform intervals, the 1-second time interval during which traffic activity is measured can affect the behavior of storm control.

The switch continues to monitor traffic on the port. When the utilization level falls back below the threshold level, the type of traffic that was dropped is forwarded again.

Use the **storm-control broadcast**, **storm-control multicast**, and **storm-control unicast** global configuration commands to set up the storm control threshold value.

Storm Control Configuration

This section describes how to configure storm control on your router. It consists of the following configuration information and procedures:

- Enabling Storm Control
- Verifying Storm Control

By default, unicast, broadcast, and multicast suppression is disabled on the switch.

Enabling Storm Control

Enable **storm-control** globally and enter the percentage of total available bandwidth that you want to be used by a all traffic (multicast, unitcast,); entering 100 percent would allow all traffic.

To enable a particular type of storm-control, use the following commands beginning in privileged EXEC mode:

	Command	Purpose
Step 1	`Router# configure terminal`	Enters global configuration mode.
Step 2	`Router(config)# [no] storm-control broadcast threshold <0-100>`	Specifies the broadcast suppression level for an interface as a percentage of total bandwidth. A threshold value of 100 percent means that no limit is placed on broadcast traffic. Use the **no** keyword to restore the defaults.
Step 3	`Router(config)# [no] storm-control multicast threshold <0-100>`	Specifies the multicast suppression level for an interface as a percentage of total bandwidth. Use the **no** keyword to restore the defaults.
Step 4	`Router(config)# [no] storm-control unicast threshold <0-100>`	Specifies the unicast suppression level for an interface as a percentage of total bandwidth. Use the **no** keyword to restore the defaults.
Step 5	`Router(config)# end`	Returns to privileged EXEC mode.

Verifying Storm Control

Use the **show storm-control** command to view switch port characteristics, including the storm control levels set on the interface.

To verify storm-control statistics on an interface, use the following commands, beginning in privileged EXEC mode:

Command	Purpose
`show interface [interface-id] counters broadcast`	Verifies the broadcast suppression discard counter for all interfaces or a specific interface. Verify the number of packets discarded.
`show interface [interface-id] counters multicast`	Verifies the multicast suppression discard counter for all interfaces or a specific interface. Verify the number of packets discarded.
`show interface [interface-id] counters unicast`	Verifies the unicast suppression discard counter for all interfaces or a specific interface. Verify the number of packets discarded.

IGMP Snooping

Internet Group Management Protocol (IGMP) snooping allows the switch to “listen in” on the IGMP conversation between hosts and routers. When a switch “hears” an IGMP report from a host for a given multicast group, the switch adds the host’s port number to the Group Destination Address (GDA) list for that group. And, when the switch hears an IGMP leave, it removes the host’s port from the content-addressable memory (CAM) table entry.

The purpose of IGMP snooping is to restrain multicast traffic in a switched network. By default, a LAN switch floods multicast traffic within the broadcast domain, and this can consume a lot of bandwidth if many multicast servers are sending streams to the segment.

Multicast traffic is flooded because a switch usually learns MAC addresses by looking into the source address field of all the frames it receives. But, since a multicast MAC address is never used as source address for a packet and since the addresses do not appear in the MAC address table, the switch has no method for learning the addresses.

IGMP Snooping Configuration

IGMP snooping is enabled by default on a VLAN. Multicast routing has to be enabled on the router first and then PIM (Multicast routing protocol) has to be enabled on the VLAN interface so that the switch acknowledges the IGMP join and leave messages which are sent from the hosts connected to the switch. For example:

```
Router(config)# ip multicast-routing
Router(config-if)# interface VLAN1
    ip-address 192.168.10.1 255.255.255.0
    ip pim sparse-mode
```

To verify multicasting support, use the **show ip igmp group** command:

```
Router# show ip igmp group
```

To verify IGMP snooping, use the **show mac-address-table multicast igmp-snooping** command:

```
Router# show mac-address-table multicast igmp-snooping
```

To verify the multicast routing table, use the **show ip mroute** command:

```
Router# sh ip mroute
```

Any Internet Protocol (IP) addresses used in this document are not intended to be actual addresses. Any examples, command display output, and figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses in illustrative content is unintentional and coincidental.

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